THE YEAR BOOK *of* GENERAL SURGERY

(*1957—1958* YEAR BOOK *Series*)

EDITED BY

MICHAEL E DE BAKEY, B.S., M.D., M.S.

Professor of Surgery and Chairman, Cora and Webb Mading Department of Surgery, Baylor University College of Medicine, Surgeon in Chief, Jefferson Davis Hospital, Houston, Texas, Senior Attending Surgeon, Methodist Hospital, Houston, Texas, Chief Consultant in Surgery, Veterans Administration Hospital, Houston, Texas

With a Section on

ANESTHESIA

EDITED BY

STUART C CULLEN, M.D

Professor of Surgery and Chairman of Division of Anesthesiology, State University of Iowa College of Medicine and Hospitals

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TO THE MEMORY OF

DR. EVARTS A. GRAHAM

To a great surgeon, a loyal friend and an accomplished editor, the publisher dedicates this volume in recognition of his 31 continuous years of devoted service.



EVARTS A. GRAHAM

(1883-1957)

IDENTIFICATION OF EVARTS GRAHAM as one of the most distinguished members of his profession would come easily to most of his colleagues. Certainly his death on March 4, 1957 stunned the surgical profession throughout the world more than the death of any other American surgeon. His warm humanity, his personal qualities as a teacher and his technical brilliance in his specialty inspired all who were fortunate enough to be numbered among his students, associates and friends.

Dr. Graham was born March 19, 1883 in Chicago. He received his A.B. degree from Princeton University in 1904 and his M.D. degree from Rush Medical College in 1907. Following his internship at Presbyterian Hospital in Chicago he devoted several years to the preclinical fields, particularly chemistry. Clinical surgery reclaimed him during the period of World War I, during which time he applied his knowledge of the physiology of the lungs and pleural cavity to the treatment of empyema. His advice to postpone thoracotomy during the acute stage of the disease saved thousands of lives during the war.

In 1919 Dr. Graham accepted an appointment as Professor and Head of the Department of Surgery at Washington University School of Medicine in St. Louis, positions he held until the time of his retirement as Emeritus Professor in 1951. During the intervening years, the stature and reputation of Barnes Hospital grew and Dr. Graham became recognized as one of the leaders of his profession. Among his notable achievements during this period were the development of the idea which resulted in the discovery of cholecystography, and on April 5, 1933 his performance of the first total pneumonectomy for cancer. He was among the first to present evidence to indicate a strong relation between cancer of the lung and cigaret smoking, a subject to which he devoted his attention until his death.

Dr. Graham was always interested in the training of young surgeons and was responsible, more than any other person,

for the formation of the American Board of Surgery, of which he was Chairman from 1937 to 1941. A versatile man, most generously endowed with research ability, a great capacity for work, fine clinical judgment and unexcelled power for the inspiration of his young associates, he gathered to him students from all over the world. From them he expected much —but he allowed them a great deal of independence. His courage in fighting for what he believed right is as well known as his code of moral and professional ethics, from which he would not deviate.

Many honors were conferred on Dr. Graham during his lifetime—both American and international. He was given honorary degrees by no less than twelve universities and colleges, including Leeds, McGill, Glasgow and Johns Hopkins. He was president of almost all the important surgical organizations with which he was associated and was the recipient of innumerable medals, including the Lister Medal from the Royal College of Surgeons, the Distinguished Service Award of the American Medical Association and the Annual Meritorious Award given by the American Cancer Society.

Because of his interests and his tremendous capacity for work, it is not surprising that he also contributed much of great value to the literature. He was the author of numerous books and edited a classic three-volume work, *Surgical Diagnosis*. He organized the *Journal of Thoracic Surgery* and was its first and only editor. In 1926 he began his editorship of the YEAR BOOK OF GENERAL SURGERY and continued it until his death. This span of 31 consecutive years is the longest of any editor in the YEAR BOOK series.

It is ironic that Evarts Graham died from carcinoma of the lung, the disease which for so long had claimed his attention. His friends will miss him because of his warmth, understanding and courage, and surgery will miss him because of his innumerable contributions and his tremendous influence on the profession.

WARREN H. COLE

PUBLISHER'S FOREWORD

DR. GRAHAM'S DEATH OCCURRED as he was beginning the selections for the present edition. This unfortunate circumstance required the immediate selection of someone to complete the work and carry on the editorship. Fortunately, we were able to obtain the services of Dr. Michael E. De Bakey who was willing to fill the breach with no preparation and complete the volume under the most trying circumstances. We are grateful to him for his immediate understanding of the problems involved and for his enthusiastic and intelligent co-operation with our staff. We welcome him to our family of YEAR BOOK editors. Our thanks also to Dr. Warren Cole for preparing the memorial to Dr. Graham which appears on the preceding pages.

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The designation (Series 1957-1958) used on the cover and title page of this volume is to indicate its publication during the "series year" which begins in September 1957.

The articles abstracted herein are taken from journals received between May 1956 and May 1957.

ANESTHESIA

INTRODUCTION

THE DEATH OF DR. EVARTS A. GRAHAM on March 4, 1957, brought to a close a truly eminent career in surgery, aptly described by Dr. Edward D. Churchill as an "illustrious performance as a surgeon, scientist and teacher." Indeed, few men have combined these roles with such talent, capability and energy. His remarkable versatility is reflected by notable achievements in all these fields of endeavor, and his fundamental contributions not only broadened but also brightened the horizons of surgery. In the words of Dr. Alfred Blalock, "The death of Dr. Graham has removed the most widely known and the most influential surgeon in the world, but the influence of such a life and work will endure."

The teachings of surgery and the elevation of its standards of practice were among Dr. Graham's earliest objectives in life, and he devoted much of his time and energy to these purposes. The fullness of his accomplishments in the field of surgical education is difficult to measure, for it includes a tremendous breadth of activity. It is mirrored in the distinguished school of surgery that he established and in the vigorous leadership he provided in national organizations dedicated toward development of higher standards of surgery. It is also reflected in his roles as editor of the *Journal of Thoracic Surgery* and the YEAR BOOK OF GENERAL SURGERY. The eminent place in surgical literature which has been attained by both of these publications through Dr. Graham's efforts could stand alone as a tribute to his greatness.

When Dr. Graham assumed the editorship of the YEAR BOOK in 1926, he became its third editor, his predecessors having been two other distinguished surgeons, John B. Murphy and Albert J. Ochsner. In his Introduction to this volume he stated with characteristic humility that when asked by the publishers to succeed Dr. Ochsner, "It was not without misgivings that I consented to do so, feeling that his ripened clinical judgment and editorial comments could not be approached by one so much younger." No better words would express my own sentiments following the invitation by the publishers to succeed Dr. Graham in this role. I would,

however, add that these sentiments are even more intensely experienced in light of the luster that Dr Graham's editorship has brought to the YEAR BOOK In accepting the editorship it is my sincere hope that the inspiration he has provided may enhance my efforts

Death came to Dr Graham in the midst of work on this latest volume of the YEAR BOOK, and its completion became the task of his successor It was characteristic of Dr Graham to continue working with courageous disregard of the nature and inevitably fatal course of his illness, and only its profoundly disabling effects within a few days of his death forced him to stop By this time, he had selected approximately one third of the articles in the current volume He had also developed an outline of its table of contents which has been only slightly modified in the final organization All of the editorial comments, however, represent expressions of the present editor

The 30 year period during which Dr Graham served in the capacity of editor saw truly immense strides in surgery, and their advancing imprints may be followed readily in the annual volumes of the YEAR BOOK To appreciate fully the great advances that have been made in surgery during this span of approximately 3 decades, one need only contrast the contents of the current volume with those of the 1926 volume Particularly striking is the change in emphasis and in point of view in some areas of surgery, the virtual disappearance of some topics that occupied much attention in the earlier volume and the phenomenal growth and development of new fields of surgery, such as those concerned with cardiovascular diseases In the earlier volume *for example,* considerable attention was devoted to asepsis and antisepsis, postoperative complications infections and gangrene In the present volume these topics have been displaced by a change in emphasis from these 'pathologic interventions' to investigations dealing with surgical metabolism, fluids and electrolytes and the underlying physiologic and biochemical disturbances produced by the stress of surgical procedures This shift in emphasis is further exemplified by the contrast in the number of articles devoted to the appendix in these respective volumes—approximately 30 in the earlier volume and only 1 in the current volume

The change in attitude toward a more aggressive approach in surgery in recent years, which has been made possible by use of more effective supportive measures, improvements in anesthesia and better control of infection, is especially noteworthy This is well illustrated by the emphasis placed in the earlier volume on graded or multiple-stage operations, then considered "one of the great surgical advances of recent years" A particularly striking example of this concept, as presented in the earlier volume, is evident in a discussion of the "role of surgery in pulmonary suppuration," in which cautery pneumonectomy was described and strongly recommended as an effective method of treatment for various forms of localized pulmonary infections, including tuberculosis In light of current surgical concepts and technics, this method of surgical treatment seems almost archaic, yet only 30 years ago it was apparently regarded as a surgical advance

Perhaps the most striking example of the rapid progress that has taken place in surgery during this period lies in the truly brilliant achievements in cardiovascular surgery Indeed, the advancements made during the past decade alone far surpass all previous efforts in this field of surgery To gain a more vivid impression of this extraordinary progress, both conceptually and in technical application, one need only contrast the 8 articles on surgery of the heart abstracted in the 1926 volume with the host of articles in the current volume Moreover, 6 of the 8 articles in the former volume were concerned with wounds of the heart, whereas in the present volume consideration is given to a wide variety of congenital and acquired diseases of the heart Of historical interest, however, and of some significance in illustrating the selective character of the YEAR BOOK in recording new developments in surgery, is the fact that the 2 remaining articles on heart surgery in the 1926 volume are concerned with the surgical treatment of mitral stenosis, the first by Souttar and the second by Cutler Another and equally striking illustration of this progressive movement in surgery is provided by the subject of aortic disease The 1926 volume, for example, contains only 1 article on this subject, and this deals with "needling for aortic aneurysm," an almost century old method of treatment long found to be ineffective

The current volume, on the other hand, includes 23 articles on this subject which are concerned both with aneurysmal and occlusive lesions of the aorta and with their efficacious surgical treatment by excision and restoration of aortic continuity

Still another impressive example of the progress that has taken place along these lines of endeavor is illustrated by the contrasting approaches and objectives of surgery in peripheral vascular disease as seen in the earlier and current volumes of the YEAR BOOK *In the earlier volume,* this phase of the subject was limited essentially to a few articles concerned with amputations for "gangrene in the aged and with the differential diagnosis of thromboangiitis obliterans The status of therapy for this problem is well described in the following sentence from one of these articles "The present treatment is unsatisfactory" In contrast with this rather limited and somewhat fatalistic point of view, the current volume includes numerous articles presenting aggressive enthusiastic and highly encouraging therapeutic approaches to this problem This much more hopeful outlook in therapy has been developed as a result of more recent pathologic and arteriographic studies which have provided a better understanding of the nature of these occlusive arterial lesions It has been demonstrated for example, that the obstructing lesion in chronic arteriosclerotic occlusive disease of the lower extremities is frequently well localized and segmental in character, with a relatively normal patent vessel above and below the occlusion This knowledge has led to development of more rational and effective therapy with a direct attack on the occlusive lesion aimed at restoration of normal circulation through the main arterial channel

These and other recent developments in surgery clearly reflect the vigor and intense activity characterizing its current status They portend other advances of even greater importance The YEAR BOOK, uniquely structured to provide an annual selective review of the surgical literature has traditionally kept pace with this progress With the future of surgery appearing brighter than ever its objective to bring to the profession these progressive developments assumes increasing gratification

MICHAEL E DE BAKEY

Tracheostomy, and Management of the Unconscious Patient is discussed by John Andrew[1] (St Bartholomew's Hosp, London) In recent years, indications for tracheostomy have been extended to include management of tetanus, respiratory paralysis and the unconscious patient

It is important to maintain a clear airway in comatose patients When consciousness is suddenly lost, this may be achieved by placing the patient horizontally and inserting a Magill airway into the mouth If this is inadequate, the trachea may be intubated through the mouth or nose

If coma is prolonged, respiration and coughing and swallowing mechanisms are usually also depressed Secretions may be aspirated and retained in the smaller bronchi Blood oxygen tension falls and CO_2 tension rises Secondary circulatory changes occur which may lead to cerebral venous congestion and edema and to pulmonary edema Tracheostomy is of value in these patients, since it halves the dead space air and facilitates mechanical suction of the trachea and bronchi A cuffed tube is advantageous in preventing aspiration of secretions from the pharynx Raising the head and shoulders allows a fuller respiratory excursion by reducing the weight of the abdominal contents on the diaphragm Venous return to the heart is improved, the danger of cerebral venous congestion is reduced

When consciousness is suddenly lost from acute intracranial lesions, it is believed the fluid is secreted by the tracheo bronchial mucus glands When coma is prolonged, the fluid is thought due to the same secretions, but a purulent broncho pulmonary infection and, terminally, pulmonary edema also develop

In coma, tracheostomy should be elective, and its performance should not be delayed until the patient has become cyanotic or peripheral circulatory failure has begun

Trendelenburg Tilt Obsolete Position, is discussed by J M Inglis and B N Brooke[2] (Birmingham, England) From the anesthetic aspect, routine use of the Trendelenburg

(1) Brit M J 2 328 332 Aug 11 1956
(2) Ibid pp 343 344

position has no advantages. It may add to the dangers and difficulties of anesthesia, causing impairment of respiration, vasomotor failure, congestion and embarrassment of heart action from increased venous return and an increased tendency to cerebral thrombosis, gastric regurgitation and nerve palsies. It is of value as an emergency measure in collapse or sudden vomiting. Steep Trendelenburg position is not essential for operations in the pelvis, since modern relaxants facilitate the pelvic approach, even in the horizontal position.

Antigravity Suit (G-Suit) in Surgery: Control of Blood Pressure in Sitting Position and in Hypotensive Anesthesia. For high-speed flying, aviation medicine has developed an inflatable suit to prevent blackout by the flyer when the

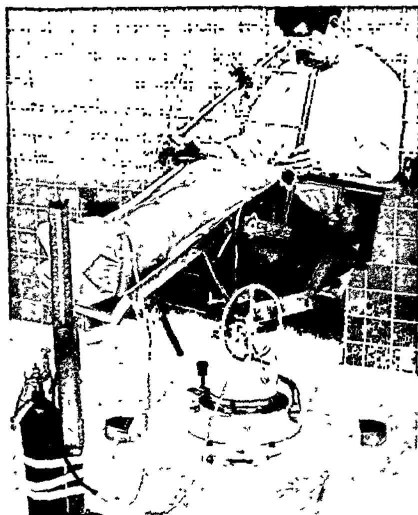


Fig 1 —G suit on patient in si[illegible] ourtesy [illegible] J, and Dohn, D F J A M A 162 274 27[illegible]

plane is pulled sharply out of a fast dive. The standard aviation garment consists of inflatable leggings and an abdominal binder which constrict the lower part of the body and prevent pooling of blood.

W. James Gardner and Donald F. Dohn[3] (Cleveland Clinic) for several years used an aviation antigravity suit to prevent postural hypotension during certain neurosurgical operations carried out with the patient in the sitting position. The suit was put on the patient before he was placed in the

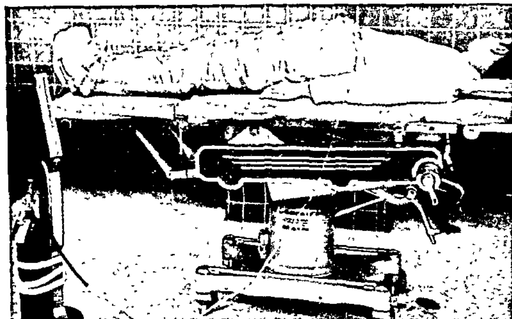


Fig. 2.—G-suit on patient in supine position (Courtesy of Gardner, W. J., and Dohn, D. F.: J.A.M.A. 162·274-276, Sept. 22, 1956.)

chair. *A fall in blood pressure during operation could be* combated by inflating the suit from a tank of gas. However, because the suit was awkward to put on the patient, a more simplified g-suit was devised, consisting of 2 sheets of vinyl plastic sealed at the edges to form a large inflatable bladder. The bladder is placed beneath the patient, the edges are folded over to enclose the rib margin to the ankles, then the suit is drawn snug by lacing. A manometer is attached to a tube leading from the upper part of the bladder. Attached to a second tube leading from the lower end is a tank of gas from which the bladder may be inflated in a few seconds

(3) J.A.M.A. 162:274-276, Sept. 22, 1956.

(Fig 1) This simplified g-suit has an advantage over the standard aviation garment in that it also compresses the pelvic area and buttocks Experience has shown that the patient's legs need not be enclosed separately to obtain the desired hemodynamic effect, that pressures in excess of 20 mm Hg are seldom indicated and that reduction of vital capacity does not result with pressures up to 40 mm Hg

The suit also is useful in operations with the patient supine, when hypotension is to be induced by drugs, spinal anesthesia or bleeding (Fig 2) With the patient supine, if the operating table is tilted so the head is elevated, the hypo tensive methods are more effective, and if the mark is overshot, the fall in blood pressure may be countered by inflating the g-suit Inflation of the suit has proved helpful when, toward the end of an operation, it is desired to raise the blood pressure temporarily to determine whether hemostasis will be satisfactory after the effect of the hypotensive drug has been dissipated

Surgery in the Aged Frank Glenn[4] (Cornell Univ) found that conditions arising in the biliary tract are the most frequent single cause of abdominal operation in the aged Of 360 patients, aged 65 and over, who underwent surgery for benign biliary tract disease, mortality was 6 9% During the same period, mortality among patients under 50 was 0 6% Symptoms of biliary tract disease in older patients varied little from those in younger ones

An elective biliary tract procedure is tolerated remarkably well by the geriatric patient, the difference in the complication and mortality rates between the aged (over 65) and the control (50 64) group is not great In contrast, the aged patient tolerates emergency biliary tract procedures relatively poorly, mortality and complication rates are strikingly higher than in younger patients This confirms that elective cholecystectomy in the aged patient with symptomatic biliary tract disease is more important than in the younger patient, who can better tolerate an emergency procedure if necessary

Acute cholecystitis may develop after surgery directed at some other organ or system Fasting, with storage of con centrated bile in the gallbladder, and the sudden attempt of

(4) Bull New York Acad Med 32 559 576 August 1956

that organ to empty itself when food is taken, is believed to produce a fulminating, obstructive type of acute cholecystitis

Acute appendicitis occurs in patients of all ages, and, in the aged, may be attended by mild symptoms of insidious onset At present, the mortality due to appendicitis is concentrated chiefly in the older age group However, if carefully evaluated and prepared, elderly persons withstand operation well In 120 patients over age 65 with acute, mechanical intestinal obstruction, the mortality was 15 08% External hernias, adhesions and neoplasms were the commonest causes of obstruction Elderly patients with intestinal obstruction are less able to withstand shock and peritonitis than are the younger and more robust Diverticulitis in the aged can be managed conservatively in about 60% of cases If surgery is indicated, it should not be side-stepped because of the patient's age Of 85 procedures performed on 41 patients, postoperative mortality was 4 8%, whereas operative morbidity was 17 6%

► [With the broadening application of surgical therapy and the gradual extension of the longevity of the general population, this problem assumes increasing importance Since atherosclerosis occurs most commonly in the aged and is so frequently the underlying cause for arterial occlusive disease this problem may be added to those discussed in this article as another condition deserving special attention by the surgeon In light of recent developments in vascular surgery and the more aggressive approach toward restoration of normal circulation the surgical management of these patients becomes particularly important —Ed]

Centralized Treatment for Seriously Ill Surgical Patients According to J Murray Beardsley, J Robert Bowen and Carmine J Capalbo[5] (Rhode Island Hosp , Providence), the shortage of nursing personnel has become such a serious problem that in many instances critically ill surgical patients suffer from inadequate, inefficient care Such patients should be segregated in an area staffed by specially trained personnel A special unit was set up for these patients at the Rhode Island Hospital, with a nursing station in the center of each wing Glass partitions allow observation of practically all patients from the nursing stations In all, there are 28 beds in 2 wings, serving an average of 295 surgical patients Private rooms are available for those with terminal conditions or those who may bother others Sleeping quarters for a full time resident are provided, as well as a laboratory, a minor

(5) J A M A 162 544 547 Oct 6 1956

surgery room and a large dressing room The unit is located on the floor directly above the operating room, which is important because most admissions are from the recovery room, located in the operating suite Each bed has available a suction outlet, oxygen device and sphygmomanometer An emergency switch is conveniently placed near each nursing station, the signal is heard in the resident's quarters on the same floor Each unit has a supervisor, graduate nurses, practical nurses, orderlies, a general-duty aide a dressing-room aide and a full-time surgical resident

All emergency patients, such as those with active gastrointestinal bleeding or severe burns, may be admitted directly to the special-care unit at the discretion of the resident-in charge All patients leaving the operating room who require special observation for variable periods may be sent directly from the recovery room to the unit on recommendation of the surgeon and anesthetist Patients with chronic conditions are not admitted to the unit

Segregation of critically ill surgical patients in a single area of the hospital provides expert care for those who need it most, relieves pressure in all other areas by lessening the need for graduate nurses and allowing for more generous use of auxiliary help, and lightens demand for private nursing care for individual patients

Studies in Surgical Endocrinology. III Plasma Concentrations of Epinephrine and Norepinephrine in Anesthesia, Trauma and Surgery, as Measured by Modification of Method of Weil-Malherbe and Bone, are reported by William G Hammond Lewis Aronow and Francis D Moore[6] (Harvard Med School) The studies were made on 4 normal volunteers who received only premedication or anesthesia 11 patients who underwent 12 operations, 3 patients with unanesthetized trauma (2 burns and 1 fracture), 2 operated on under hypothermia and 1 having total adrenalectomy for hypertension Except for 2 who died of extensive burns all had moderate trauma None of the patients had oligemic or hypotensive shock

The free serum 17 hydroxycorticoids are commonly elevated during and after anesthesia and trauma, without parallel elevation of venous plasma epinephrine or norepinephrine

(6) Ann Surg 144 715 732 October 1956

levels Response of blood 17-hydroxycorticoid to surgical trauma is predictable Of those epinephrine-norepinephrine values which were elevated, a significant fraction were elevated 1-24 hours before operation In 2 extensively burned patients, both epinephrine and norepinephrine were elevated, particularly epinephrine, and in 1 burned patient, severely ill and passing into a terminal phase of respiratory infection, epinephrine was remarkably elevated

One patient, after adrenalectomy, had a plasma epinephrine concentration of substantially zero, whereas plasma norepinephrine remained unchanged In 1 patient who had ulcerative colitis, but was not acutely ill, plasma epinephrine was elevated when the colon was in place, but returned to normal after colectomy In the normal volunteers, the threat of operation and anesthetic agents alone, including ether, Pentothal®, nitrous oxide-curare or spinal, produced no significant increase in peripheral venous plasma epinephrine-norepinephrine concentration

Clinically, tachycardia and narrow pulse pressure (rising diastolic pressure associated with increased peripheral resistance) have been considered evidence of a sympathico adrenal effect during anesthesia or surgery after injury Such effects have been noted during induction of anesthesia in patients with massive unanesthetized trauma such as occurs in combat casualties, in patients with marked psychologic dis turbances or in oligemic shock The only one of these four situations studied was the induction phase of anesthesia, but no elevation of epinephrine-norepinephrine was detected

In most of the patients with trauma, the blood eosinophils decreased and the blood and urine 17 hydroxycorticoids increased These studies confirm previous observations with respect to eosinophils and steroids and further show lack of correlation between the response of these substances and that of epinephrine norepinephrine

Surgical Treatment as Complicated by Prior Adrenocortical Steroid Therapy Accumulating evidence shows that prior treatment with either ACTH or cortisone may significantly alter a person's ability to effect necessary adjustments to a stressful situation such as an operative procedure With expanding use of steroid therapy for hospitalized and ambulatory patients, clinicians must be alert to the serious delayed

consequence of shock occurring during and after even simple operative procedures of common incidence Mark A Hayes[7] (Yale Univ) suggests the following management for steroid-treated patients

METHOD —When the patient is known to have received either steroid or ACTH therapy in the past but is not receiving either at the time, the eosinophil response to an 8-hour infusion of 5% dextrose in distilled water containing 20 units of ACTH is determined An 80% decrease in eosinophil count *should be present over the first 4 hours* and a further fall to 90% over the next 40 These results constitute a positive test and indicate the existence of an adrenal cortex capable of responding to ACTH Operation is conducted without further preparation If there is less than an 80% fall over the first 4 hours, 8-hour infusions of 20 units of ACTH are repeated daily until a satisfactory response is obtained Operation is then conducted with a constant infusion containing 20 units of ACTH/L Rate of administration is controlled by the anesthetist Infusion is continued throughout the day of operation For the first postoperative day 20 mg of ACTH is given every 4 hours intramuscularly Each subsequent day a single alternate dose is omitted, simulating the gradual physiologic decrease in pituitary ACTH release that occurs in normal convalescence Postoperative complications will increase the steroid requirements and should be managed with increasing amounts of the tropic hormone, if and when they occur

When the patient is receiving adrenocortical steroids at the time of operation, daily 8-hour ACTH infusions are administered as the steroid is gradually withdrawn, usually requiring 3 5 days This conversion is followed closely by the 4- and 8-hour eosinophil counts When the patient is adequately prepared, operation and convalescence are managed as outlined

A serious situation arises when the patient is not known to have received steroid therapy until shock occurs, usually during the operation Existence of relative adrenocortical insufficiency contributory th

count should be done at once if it is more than a very low figure, steroid therapy should be started at once If facilities for doing the eosinophil count are not available a therapeutic trial of steroid ad

ng hydrocortisone

pressure response

isufficiency Maintenance for the remainder of operation is obtained by giving *200 mg* of the steroid in each 500 cc blood During convalescence a tapering schedule of the soluble steroid is given intramuscularly at frequent intervals over the next 3-5 days

Since this paper was written, the following program of

(7) Surgery 40 945 950 November 1956

management has proved as satisfactory as ACTH On the 1st preoperative day, 50 mg cortisone is given intramuscularly in each of 4 sites at 6 p m On the operative day, 50 mg hydrocortisone is given intramuscularly in each of 2 sites just before premedication, 100 mg hydrocortisone in each 500 cc blood or fluids is given during operation, and at the end of operation, 100 mg hydrocortisone intramuscularly

Results in Patients Treated with Coil Kidney (Disposable Dialyzing Unit). Willem J Kolff, Bruno Watschinger and Victor Vertes[8] (Cleveland Clinic) report the biochemical details of 11 dialyses in 8 patients to show the reduction of blood urea thus achieved, in 1 patient 50 Gm urea were removed at one session and 66 Gm at another Five patients had chronic uremia due to chronic renal disease and hypertensive cardiovascular disease that precluded durable clinical benefits, although 1 was improved for 3 months Three patients had acute uremia One with acute anuria following an abdominal operation died of peritonitis after initial improvement and establishment of diuresis One who had acute anuria as part of a hepatorenal syndrome and 1 with anuria following a transfusion accident and hysterectomy recovered

Increase in blood pressure was seen in most patients after 3 5 hours of dialysis, these rarely exceeded 20 mm Hg and presented no serious problem Rises in temperature were slight Oozing of blood from cut-down sites in 4 patients was not serious and stopped after removal of the cannulas and closing of the wounds Fall in blood urea and creatinine after 5 7 hours indicated that performance of the coil kidney approaches that of the most effective artificial kidneys now available

The coil kidney consists of a stationary coil of cellulose tubing separated by Fiberglas screens, which allow a limited distention when the tubing is filled with blood The layers of screens and tubing are sewed in large rolls A strip with 2 cellulose tubes in parallel arrangement makes a "twin" kidney Ten meter lengths of finished rolls are fitted with inlet and outlet tubes for blood and are coiled around a fruit juice can 10 cm in diameter The finished coil is fitted into a larger can (Fig 3), with a garden hose connection for the rinsing fluid at the bottom Inflow and outflow tubes are stored in

(8) J A M A 161 1433 1437 Aug 11 1956

the can, and a lid or top is sealed on in a household can sealer The entire unit may be sterilized either in an autoclave or with ethylene oxide as in industrial sterilization The coil kidney can then be shipped and stored and is ready for use after having been washed out with saline At time of use, the top of the can is removed with a can opener and tubes for in flow and outflow of blood are found inside The entire unit is placed in or over a 100 L reservoir filled with rinsing fluid which is pumped in through the garden hose connection in

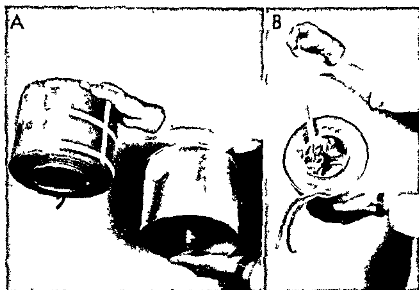


Fig 3 —Twin kidney completed with inlet and outlet tubes for blood is held next to *A* and in *B* large tin can in which it is sealed for storage In bottom of can is garden hose connecting piece through which rinsing fluid enters can during actual operation (Courtesy of Kolff W J *et al* J A M A 161 1433 1437 Aug 11 1956)

the bottom It flows out over the open top of the can and back into the reservoir While the blood circulates around in the coiled tubing, the rinsing fluid circulates crosswise through the wire mesh A simple pump (Sigmamotor) may be used to pump the blood Another (Hypro portable pump) is nec essary to circulate the rinsing fluid A tank for rinsing fluid is stainless steel (100 L for easy calculation) with large in flow and outflow pipes and thermostatic control at 37 39 C (100 102 F) The initial investment in additional equipment need not exceed $800

The twin coil kidney requires 750 900 ml blood for prim ing it has a dialyzing area of 18 000 sq cm and requires a rinsing fluid flow rate of at least 3 L/minute At a blood

flow rate of 200 ml/minute, the urea clearance is 140 ml/minute, provided the rinsing fluid is fresh To overcome resistance inside the coil, and for return of blood to the patient's vein, a required pressure of 160-180 mm Hg is delivered by the blood pump

The advantages of a disposable coil kidney, if it becomes commercially obtainable, will be mainly ease of operation and elimination of time consuming cleaning, sterilizing and setting up

Homograft Rejection Mechanism. M T Edgerton, H A Peterson and P J Edgerton[9] (Johns Hopkins Univ) studied the detailed vascular morphology accompanying skin grafts in mammals The transparent chamber technic was modified to permit study of skin grafts under more physiologic conditions Over 300 autografts and over 300 homografts were studied, using inbred mouse strains Additional visibility for observations within the chambers was obtained by surgical insertion of a disk of optical glass beneath the bed of the graft

Homografts and autografts showed identical initial vascular responses during the period of "take" The timing of these changes was the same for both autografts and homografts, but was somewhat influenced by the thickness of the grafts and the vascularity of the recipient bed Homograft rejection of skin began on the 9th day This rejection end point was constant and consisted of sudden reduction in the caliber of the larger graft vessels, accompanied by slowing of the flow rate in these vessels It was almost invariably preceded, 12 24 hours before, by hyperemia or sympathetic response in the vessels of the host bed

Unless sepsis is allowed to occur, rejection of skin homografts is unaccompanied by thrombosis in the vessels of the graft bed The establishment of active circulation in any autograft or homograft largely depends on the actual end-to-end anastomosis of graft vessels with those of the host When rejection of a homograft begins, the vascular pattern of the graft begins to disrupt and disappear rapidly The pattern of graft vessels in autografts persists as long as the experiments have been followed (over 12 months in some animals)

(9) A M A Arch Surg 74 238 244 February 1957

Theory of Protease Activation and Its Role in Rejection of Homotransplants Rejection of homotransplants has been thought due to an immune response of the host Since destruction of tissue is involved, a hypersensitive reaction may be postulated The protease activation theory of hypersensitivity may explain a possible chain of events leading to rejection of a homotransplant Protease activation is thought the result of an initial antigen antibody reaction which stimulates or activates proteolytic enzymes and so causes injury or death of cells To test this theory, Creighton A Hardin Alvar A Werder, Wilford D Hoofer and Marvin S Liggett[1] (Univ of Kansas) studied protease activity in skin grafted mice Experiments with hypersensitivity show a rise in circulating serum protease followed by an antiprotease after sensitization with certain proteins Burdon s film strip method was used to demonstrate antitryptic activity

Whereas the antitryptic titer for normal mice was 150-175 in mice with implanted homografts, the antitryptic index rose sharply on the 8th day, reached a peak of 450 on the 14th day and then returned to normal Irradiation alone lowered the titer on the 8 10th day but it returned to a normal level on the 14th day Irradiation with a subcutaneous homograft yielded a progressive increase in antitryptic titer during the first 2 weeks with a rapid elevation to 400 by the 18th day after which it gradually returned to normal The antitryptic titers in these experiments closely paralleled the necrosis and death of the homografts Irradiation or injection of skin extracts depressed the antitryptic titer and prolonged the life of the homograft

► [The two preceding articles by Drs Edgerton and Hardin and their co workers reflect the increasing interest and more intensive studies now being devoted to the subject of tissue transplantation Successful homotransplantation of fetal tissue in the human has been reported (see section on parathyroids p 102) Successful homotransplantation of adult tissue with long term survival is yet to be accomplished other than in identical twins however there are many encouraging leads to be followed Solution of this problem offers promise of great significance in surgery —Ed]

Fat Embolism in Korean Battle Casualties Incidence Clinical Significance and Pathologic Aspects The significance of fat embolism following trauma continues to be controversial Some authors regard fat embolism as a relatively common and serious complication of injury others believe

(1) Surgery 41 752 755 May 1957

that it is rarely severe enough to be of clinical importance. Surgeons who handled large numbers of battle casualties in the Korean conflict only exceptionally were able to recognize the clinical syndromes described in the literature as characteristic of fat embolism. Because of such conflicting opinions, Robert E. Scully[2] analyzed 110 autopsy cases of all types of trauma, including battle, from a clinicopathologic viewpoint in an attempt to determine the specific significance of fat embolism among the many sequelae of serious injury. All patients died at military hospitals up to 4 weeks after battle trauma.

Fat embolism, evidenced by fat droplets in the pulmonary vessels, was demonstrable in about 90% of the 110 patients. In only 19% was the degree of pulmonary fat embolism more than slight. Only 4% showed more than slight systemic fat embolism, evidenced by fat in the kidneys, and only 1% showed fatal (cerebral) fat embolism.

Analysis from both clinical and pathologic viewpoints does not show that fat in the lungs causes pulmonary dysfunction or death. This finding is at marked variance with the concept of the significance of pulmonary fat embolism accepted in the literature.

Fat emboli may be recognized and quantified with considerable accuracy without use of fat stains by searching for and estimating the amount of intravascular vacuolation. This method can be used with greatest success in the lungs and with somewhat less success in the kidneys.

Investigations with Regard to Pathogenesis of So-called Fat Embolism: Serum Lipids and Tissue Esterase Activity and Frequency of So-called Fat Embolism in Soft Tissue Trauma and Fractures. S. R. Johnson and A. Svanborg[3] believe that so-called fat emboli do not consist of marrow fat torn loose through injury. This is indicated by the following observations: (1) fat emboli are found in many cases without injuries to bones or soft tissues, (2) they occur a remarkably long time after trauma, (3) a discrepancy exists between extent of trauma and frequency of fat embolism, (4) fat emboli are found in capillary systems distal to the lungs and (5) are found often in ordinary postmortem material.

(2) Am J Path 32 379 403, May-June, 1956
(3) Ann Surg 144 145 151, August, 1956

The hind leg of male rabbits was crushed or ligated to produce venous stasis After injury, fat colorable with sudan was observable in tissue capillaries Fat of the type commonly considered pathognomonic of so-called fat embolism occurred as frequently after soft tissue injuries as with fractures Within 48 hours after trauma, an increase of total fat, cholesterol and phosphor lipids was present in serum A 30 minute ether narcosis started a less pronounced increase in serum lipid, occurring later Injury or ether narcosis did not change esterase activity in vitro of hepatic or renal tissue This refuted the assumption that increase in serum lipid after trauma is due to reduced decomposition of lipids

The frequency of fat embolism is not proportionate to the quantity of lipids in the serum So called fat embolism, i e, the occurrence in capillaries of parenchymatous organs of lipids colorable with sudan, probably denotes qualitative change of serum lipids It cannot be considered definitely established that the occurrence in the organ capillaries of fat colorable with sudan is of clinical importance The presence of these fatty droplets is one change in a complex of symptoms comprising shock, tissue injuries and change in the emulsification of serum lipids

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SHOCK, FLUIDS AND ELECTROLYTES

Carbon Balance· Clinical Approach to Energy Exchange Carbon dioxide leaving the body represents the end stages of oxidation of carbon chains arising from fat, carbohydrate or protein This is via a final common pathway, the tricarboxylic acid cycle The rate at which this cycle is turning over is reflected in the amount of carbon dioxide produced/unit time John M Kinney and Francis D Moore[4] (Harvard Med School) present a method of calculating carbon balance which provides direct evidence of energy utilization in the surgical patient The method uses a modified BMR apparatus with an air-scrubbing technic for accurately recovering the carbon dioxide and allowing simple measurement

By considering the surgical patient as a metabolic machine,

(4) Surgery 40 16 26 July 1956

the authors feel that following body output of carbon dioxide provides a direct external gauge of the rate at which this machine is turning over and, therefore, the magnitude of energy demands which must be met by food or body stores This approach is useful in studying both the route and rate of supply, as well as ideal composition of the diet for preoperative preparation of depleted patients

Indirect evidence suggests that the balance of all carbon compounds, including protein, is altered following surgical stress Carbon balance data appear to provide a helpful framework for future isotopic exploration of intermediary pathways and further investigation of neuro endocrine influences that cause metabolic changes at the enzyme level

► [*This rather simple approach to a complex problem may prove to be one of the most significant developments in the study of surgical metabolism —Ed*]

Use of Intravenous Lipoid Substances in Surgical Patients Donald E Hine, Harold A Harper, H J McCorkle and Louis G Brizzolara[5] (Univ of California) administered an intravenous fat emulsion, 10% sesame oil in 4 5% dextrose solution with 0 5% lecithin added as a stabilizer, in doses of 500 cc to 27 patients for a total of 112 infusions, and found that when the emulsion was given at rates of 100 150 cc / hour, there were few reactions except for occasional slight rise in body temperature Size of the fat particles was less than 1 μ The emulsion was water-like in viscosity and isoosmotic with blood

The emulsion was given in the pre- and postoperative periods to well-nourished and malnourished patients In the immediate postoperative period, provision of extra calories in the fat emulsion did not affect loss of endogenous or exogenous nitrogen This was true regardless of the preoperative nutritional state of the patient and the magnitude of the surgical trauma The fat emulsion was readily utilized by and contributed substantially to the nutritional welfare of the postoperative patients

Observations on Patient Tolerance with Intravenous Administration of Fat Emulsion are reported by Paul H Jordan, Jr Phillip Wilson and John Stuart[6] (Univ of California, Los Angeles) Fifteen lots of an emulsion (stored at

(5) Am. J Surg 92 292 299 August 1956
(6) Surg Gynec & Obst 102 737 747 June 1956

room temperature for a maximum of 5.2 months) containing 10% sesame oil, 0.65% soybean phosphatides and 4.5% dextrose were administered in 633 infusions of 350-2,000 ml to 209 patients. In 62% of the infusions there were no reactions except temperature changes. Energy lost as a result of temperature elevations was not important, averaging 4-8% of the calories administered. Of 38% of the infusions with reactions, interruption was necessary in only 6%. Side effects fell into 3 groups with respect to time of onset. Back pain (10.8%), flushing (6.8%), chest pain (2.4%) and dyspnea (4.4%), if observed, usually occurred after administration of a few drops or milliliters of emulsion. Chills and associated pyrexia (8.9%) did not occur before 100-300 ml of emulsion were given. Headache (10.4%), nausea and vomiting (12%), arthralgia (1.6%) and blurring of vision (2.5%) rarely occurred before 500 ml were given. Rashes (2.1%) were of two types: (1) generalized urticarial wheals appearing after a small volume of fat emulsion, and generalized urticarial wheals usually disappearing promptly after antihistaminics; (2) a maculopapular eruption appearing after large infusions of fat emulsion, uninfluenced by antihistaminics and persisting several days.

Reactions may be due, not to the composition and structure of the fat emulsion, but to its interaction with the patient's body in a particular physiochemical state. Some patients tolerate large volumes of fat with no difficulty; some are completely intolerant; others react differently at various times. Whether the variation in tolerance is due to normal physiologic alterations or secondary to disease is speculative.

The incidence of reactions was significantly greater (75%) in patients with hepatic dysfunction. Fat emulsion was not so well tolerated immediately after operation as at other times, possibly due to altered hepatic function secondary to general anesthesia. Patients with ulcerative colitis and regional enteritis tolerated fat emulsion poorly, perhaps also because of hepatic dysfunction. Two attempts to administer fat emulsion to a patient with severe adrenal insufficiency resulted in prompt and serious reactions. Intravenous fat emulsion is avoided in patients with severe cardiac disease, since increased oxygen consumption associated with severe chills may increase myocardial ischemia.

Fat emulsion may benefit a large percentage of carefully selected patients for whom parenteral nutrition is important, without causing any adverse reaction As understanding of the nature and incidence of reactions increases, fear of these will decrease

Safety of Stored Liquid Plasma: Clinical Study. Pooled plasma has been discarded in the treatment of shock, chiefly because of the high incidence of serum hepatitis Ultraviolet irradiation or chemicals are either impractical or ineffective Storage of liquid plasma at room temperatures for 6 or more months was first reported to be effective in inactivating the virus of serum hepatitis in 1950 This finding was confirmed by Paul I Hoxworth and Walter E Haesler, Jr[7] (Univ of Cincinnati) in a clinical trial of stored plasma obtained from 3,290 donors and given to 164 patients Among these patients no jaundice occurred The expected incidence of serum hepatitis is between 1 and 22% with untreated plasma

Existing blood bank organizations have a vast potential for producing plasma for civilian and military use If the danger of serum hepatitis can be overcome, plasma can again return to its appropriate place in hemotherapy In ordinary civilian use, it is simple to employ room temperature storage for plasma Outdating losses of whole blood ordinarily exceed the demands for plasma Thus, reserves may be expanded for emergency use Plasma may be stored as liquid for 6 or more months and then frozen and dried for longer storage Adequate stores of safe plasma would be of tremendous importance in civilian practice and for any mass casualty, military or civilian

A simple and practicable method for inactivating serum hepatitis virus is of incalculable importance It should permit the pooling of plasma to avoid blood group (ABO) considerations

Blood Transfusion by Intraperitoneal Route was successfully administered by Malcolm E Waite, David D Colucci and Jerome Glaser[8] (Rochester, N Y) in a child with thalassemia major, and they suggest it for small children and patients who have had repeated transfusions resulting in

(7) Ann Surg 144 336 346 September 1956
(8) A M A J Dis Child 91 561 565 June 1956

thrombosis of peripheral veins and other local effects, particularly from cutdowns.

TECHNIC —Blood, typed and cross-matched against the patient's cells and serum, is prepared as for intravenous transfusion The filter tube leading to the bottle is attached to a 3 way stopcock to which is attached a 20 cc syringe and a tube leading to a no 20 needle, the point of which is not needle sharp Syringe and tubes are filled with *sterile isotonic saline solution*

The patient is restrained in the supine position, and the abdomen carefully palpated and percussed to delineate the size and position of the liver, spleen and bladder The patient is then prepared as for abdominal paracentesis In absence of contraindications, such as large organs or masses, the needle is introduced at either lateral margin of the rectus abdominis, about midway between the level of the umbilicus and the symphysis pubis

When the needle is in the peritoneal cavity, the saline solution may be injected easily without resistance, and no saline will be recovered on aspiration with the syringe if only enough is injected to determine the patency of the needle and that it is free in the peritoneal cavity The remaining saline solution is discarded, and blood introduced by alternately drawing it into the syringe and discharging it into the peritoneal cavity

After the required amount of blood has been injected, the needle is withdrawn and the puncture covered with a dry, sterile dressing If the patient is restless a sedative is given or restraint imposed The patient is then observed for 12 hours (particularly with respect to melena) and discharged, unless complications have occurred

Complications are rare Fluid blood in the peritoneal cavity is not harmful The possibility of perforation of the bowel is highly remote Because of the slower entrance of blood from the peritoneal cavity into the blood stream, it is doubtless safer to administer a larger amount by intraperitoneal than by intravenous transfusion Although the authors used citrated blood, there is no objection to heparinized blood Patients tolerate intraperitoneal transfusion well

► [The intraperitoneal route of blood transfusion was introduced more than 30 years ago especially for infants and children because of its technical facility This advantage however, is far outweighed by its disadvantages which include slow absorption of blood into the circulation and the danger of intestinal perforation For these reasons it was never widely adopted and has been virtually abandoned This effort to revive the method will undoubtedly meet the same fate —Ed]

Silicone Rubber Tubing in Blood Transfusion Work: Clinical Trials John F Wilkinson, G G Freeman, N New and R B Noad[9] report results of 296 transfusions of whole blood, packed cells and serum through 7 types of silicone rubber

(9) Lancet 2 621 624 Sept 22 1956

tubing Only 3 transfusion reactions were observed (1 01%) This is of the same order as observed with natural rubber tubing under similar conditions at the same clinic

The most satisfactory specimens of silicone rubber withstood many sterilizations by autoclaving without serious deterioration Four compositions of silicone rubber could still be used after over 40 transfusions, and one reached 59 The most satisfactory compositions were a dimethylpolysiloxane gum filled with an amorphous precipitated silica or a pyrogenic silica In contrast, various natural rubber tubings under similar conditions showed much deterioration after 6-12 sterilizations Silicone rubber could be stored a long time without deterioration

The general water repellent properties of silicone led to reduced wetting by fluids including blood, and reduction in the tendency for coagulation on the surface during prolonged transfusion The most satisfactory silicone rubbers used were transparent This facilitated initial displacement of air from the tubes by saline solution Silicone rubber tubing was superior to natural rubber for procedures involved in separation, storage and therapeutic use of platelets which adhere to natural rubber

Thrombocytopenia and Hemorrhage in Hemolytic Blood Transfusion Reactions P W Pifer, M A Block and C P Hodgkinson[1] (Henry Ford Hosp) found that intravenous administration of heterologous blood experimentally resulted in an abnormal bleeding tendency similar to that in hemolytic blood transfusion reactions in man A critical precipitous fall of blood platelets occurred, as well as a small decrease in plasma fibrinogen Bleeding time was usually and coagulation time frequently prolonged These changes usually lasted only several hours Intravenous administration of protamine sulfate did not significantly influence these abnormalities

Platelet depression appeared to be of major importance in the etiology of the bleeding tendency observed experimentally Whether it is the primary reason for the bleeding tendency associated with incompatible blood transfusions in man is unknown

Fibrin and platelet emboli or thrombi form in blood vessels

(1) Surg Gynec & Obst. 103 129 135 August 1956

throughout the body as a nonspecific reaction, occurring in a number of conditions in which foreign proteins are present in the blood stream This condition then results in thrombocytopenia and hypofibrinogenemia and a bleeding tendency In varying situations, either thrombocytopenia or hypofibrinogenemia may predominate

Hemorrhage during and after Operation Secondary to Changes in Clotting Mechanism: Physiology and Methods of Control Eugene E Cliffton, Carlo Grossi and Malcolm Siegel[2] (Cornell Univ) studied the clotting mechanisms of 55 patients undergoing major surgery, before, during and after operation Excessive oozing from the wound during the procedure was observed in 8 patients All had fibrinolytic activity in the blood associated with low plasma fibrinogen in all but 1 One of the patients with oozing died at surgery In the nonoozing group of 47 patients, major surgery produced a moderate drop in plasma fibrinogen and changes in other clotting factors similar to those in the oozing group Significant fibrinolytic activity without oozing, was seen in 4 patients, 3 of them had no decrease in fibrinogen level

Treatment of the oozing syndrome is still empiric The most satisfactory treatment seems to be cessation of operative trauma and anesthesia and closure of the wound Bank blood has been castigated as being extremely deficient in clotting factors Relatively fresh blood, however, has good fibrinogen levels (250 mg/100 ml), active antifibrinolysin some platelets and good levels of prothrombin and stable factor Only the labile factor is rapidly lost and this can be replaced with fresh frozen lyophilized plasma The highest levels of all clotting factors are present in fresh ideally prepared blood or except for platelets, in fresh frozen plasma

Changes in Coagulation Occurring in Dogs during Hypothermia and Cardiac Surgery were studied by Paul R Ellis Jr LeRoy J Kleinsasser and Robert J Speer[3] (Baylor Univ) with the technical assistance of Jo Ann Finley They found a depletion of proaccelerin proconvertin prothrombin and fibrinogen This depletion was probably due to intravascular clotting which predisposed also to thromboembolism Several deaths occurred with hypothermia and

(2) Surgery 40 37 53 July 1956
(3) Ibid 41 198 210 February 1957

cardiac surgery which were believed attributable to pulmonary emboli. Intravascular clotting also depleted the blood of certain factors necessary for coagulation, resulting in a clotting defect. Hemorrhage after rewarming was a significant problem in animals undergoing hypothermia and cardiac surgery.

Heparin was given intravenously to inhibit intravascular clotting. Depletion of coagulation factors was minimized. No animals so treated showed thromboembolic phenomena, mortality was greatly reduced and no postrewarming hemorrhage occurred.

Chlorpromazine and Hypothermia in Experimental Traumatic Shock. J. F. Cier and M. Lanche[4] describe experiments in dogs in which severe traumatic shock was produced by the method of Hermann and Jourdan. Chlorpromazine given either before or after production of the shocking injury, had no effect on the course of the shock. Progression toward death was, in fact, especially rapid. Conversely, the course of shock was definitely slowed when chlorpromazine was used in combination with induced hypothermia in animals subjected to similar trauma. In the nonrefrigerated animals, survival after crushing injury was 2-5 hours. The survival times in refrigerated animals receiving chlorpromazine (2 mg/kg) either before or after injury, ranged from 4 hours 45 minutes to over 24 hours in all but 1 animal that died within 2 hours. Three animals survived traumatic shock for 24 hours. The survival time of refrigerated animals was more than double that of those whose physiologic temperature was maintained.

Hypothermia was produced easily in the dogs anesthetized with pentobarbital and treated with chlorpromazine. Shivering and other reactions to cold were practically abolished. Blocking of thermoregulatory mechanisms to cold, however, is not a specific effect of chlorpromazine.

Any adaptation of these experimental findings in practice would have to be made with extreme caution. Physiology of the severely chilled organism is still imperfectly known, and the possibility of neurologic complications, particularly of ventricular fibrillation, presents real hazards.

(4) Lyon chir 51 435-447 May-June 1956

Experimental Hemorrhage· Deleterious Effect of Hypothermia on Survival and Comparative Evaluation of Plasma Volume Changes To study response to severe but sublethal hemorrhage, John N Wilson, Strother B Marshall, Virginia Beresford, Vernon Montgomery, Dalton Jenkins and Henry Swan[5] (Univ of Colorado) developed a standard preparation which involved rapid arterial hemorrhage of 35% of measured blood volume in splenectomized dogs anesthetized with pentobarbital

Using this preparation, a study of the effect of hypothermia on the survival rate following hemorrhage revealed a progressive diminution in tolerance as body temperature was lowered below 31 C Mortality rate was zero in normothermic animals, but was 82% when body temperature was between 26 and 20 C

Following hemorrhage, plasma volume rapidly increased by a shift of fluid into the intravascular compartment At all temperatures, maximum response was usually achieved within 30 minutes The amount of plasma volume increase was progressively less as body temperatures were reduced Correlation between magnitude of plasma volume change and magnitude of blood pressure change following hemorrhage was remarkably close Change in arterial blood pressure may be a controlling factor in regulating rapid plasma volume changes, irrespective of temperature

In the warm animal, at least some and usually most of the fluid causing elevated plasma volume immediately following hemorrhage, left the vascular compartment, usually within *1 3 hours Blood pressure returned toward normal during* the same period when plasma volume was falling Dilution of plasma, therefore, did not appear essential for maintenance of blood pressure recovery after hemorrhage

Hypothermia I Effect on Renal Hemodynamics and on Excretion of Water and Electrolytes in Dog and Man Hypothermia often is used during vascular surgery in an attempt to reduce the metabolic demands of isolated vascular beds that are subjected to ischemia when vascular occlusion is required Since homograft replacement of the abdominal and the thoracic aorta is now feasible, it often becomes necessary to interrupt the blood supply to the kidney When renal is

(5) *Ann Surg 144 696 714 October 1956*

chemia is prolonged, renal failure may result Therefore, any method for reducing renal damage during this period of ischemia is of advantage to the surgeon Likewise, the effect of reduction in body temperature alone should be known John H Moyer, George Morris and Michael E De Bakey[6] (Baylor Univ) studied the effects of reduced body temperature on renal function in 39 dogs and in 11 patients in whom the hypothermia was used to facilitate vascular operations

As body temperature was progressively reduced to 27 C (laboratory observations), the mean blood pressure decreased progressively to about 75% of control values This was associated with a progressive reduction in the glomerular filtration rate and renal blood flow, without significant changes in urine or sodium excretion

Reduction in the glomerular filtration rate and in renal blood flow did not improve when blood pressure was raised to control values with an infusion of norepinephrine However, when body temperature was again increased to control levels, the mean blood pressure returned to control levels, although the glomerular filtration rate and renal blood flow usually returned to only about 75% of control levels However, within 24 hours, these had returned to control levels in those dogs studied There was essentially no difference in these responses between dog and man

Mechanism of Hyponatremia and Hypotonicity after Surgical Trauma was studied by Jerome J DeCosse, Henry T Randall, David V Habif and Kathleen E Roberts[7] (New York City) Hyponatremia, hypochloremia and renal retention of exogenously administered sodium and water in the immediate postoperative interval are well recognized Studying patients undergoing surgery, the authors found that the hyponatremia and hypochloremia could be explained by expansion of the extracellular fluid, and that total extracellular sodium and chloride may actually be increased postoperatively Extracellular fluid expansion occurs at the expense of the intracellular compartment There may be elevated intracellular osmolality from losses of intracellular water without equivalent electrolytes, thus changing intracellular-extracellular osmotic relations, and this may be partly

(6) Ann Surg 145 26-40 January 1957
(7) Surgery 40 27 36 July 1956

responsible for the increased secretion of antidiuretic hormone which triggers and then maintains water retention postoperatively.

In treatment, it should be recognized that hyponatremia and extracellular fluid expansion are a natural sequence in the postoperative patient and *are usually asymptomatic and* self-limiting. Excessively administered fluid or electrolytes are not normally excreted in the postoperative interval because of antidiuresis and increased adrenal cortical activity. *Nevertheless, the tendency toward hyponatremia and cellular* hyperosmolality requires that water and sodium should not be restricted too rigidly. However, no attempt need be made to bring these levels back to "book normal" by infusion of sodium chloride solutions. *Indeed, excessive infusion* of these electrolytes seldom succeeds in restoring "normal" levels and risks overexpanding the extracellular fluid space.

Endocrine Mechanisms Involved in Water and Sodium Metabolism during Operation and Convalescence was investigated by M. A. Hayes, R. J. Williamson and W. F. Heidenreich[8] (Yale Univ.). Inexplicable disturbances in water metabolism without consistent alterations in electrolyte metabolism have been seen after trauma or operation that are best attributed to some undefined or poorly delineated alteration in water metabolism itself.

Whereas anesthesia may initiate a disturbance in water excretion, operative trauma is necessary to perpetuate it. There is a distinct correlation between the magnitude of the operative trauma and duration of the altered ability to excrete a water load. Although biologic identification of antidiuretic activity is lacking, experimental results make it nearly mandatory to accept an antidiuretic mechanism as being active after trauma. It seems logical to accept the neurogenic release of antidiuretic activity from the posterior pituitary as the mechanism involved in post-traumatic water retention. Since the water retention occurs in the presence of progressive and often alarming decrease in serum osmolarity, it may be assumed that it is "centrally driven," that is, forcibly discharged comparable to the mechanism that elevates the levels of adrenocortical steroids in the serum, both being instances of disturbed physiologic equilibrium.

(8) Surgery 41 353-386, March, 1957.

The authors found it possible to administer fluids such as 5% glucose in distilled water to compensate for insensible loss in postoperative patients on a metabolic basis This loss is rounded off conveniently to 750 ml /sq m /24 hours If this amount is added to the values recommended for obligatory urinary function, the total requirements, excluding abnormal losses by drainages, total 1,000 ml /sq m /24 hours for the operative day, adding 250 ml /sq m each of the 2 successive days

Little evidence was found that pituitary-controlled adrenocortical steroids play a major role in the well-recognized postoperative intolerance to sodium Primarily it is the result of increased aldosterone secretion from the adrenal cortex, *occurring independent of pituitary control and related to* prior or operative period restricted sodium intake

Trauma influences hypothalamic centers through the mediums of various neural effectors and possible humoral mediators By disturbing the usual homeostatic mechanisms operating in the hypothalamus, its effect on the pituitary gland is altered, by neural connections, the posterior pituitary (the neurohypophysial system) discharges antidiuretic hormone, and, by probable humoral influences, the anterior pituitary discharges at least thyrotropic and adrenocorticotropic hormones, each acting on its specific target gland

Thyrotropic and adrenocorticotropic effects on the thyroid and adrenal cortex are antagonistic and a new level of physiologic equilibration is effected Among the other metabolic effects of the increased release of adrenocortical steroids controlled by the anterior pituitary is the possible increase in renal excretion of sodium, tending to a lowered serum sodium concentration

Conversely, the increased antidiuretic activity when water is supplied too rapidly or in amounts beyond metabolic requirements results in primary water retention and serum dilution leading to a lowered serum sodium concentration The lowered serum sodium level, with an inadequate sodium intake, acts independently of any known controlling mechanism to increase adrenocortical release of aldosterone, which effects maximum renal sodium conservation

Practical implications from and applications of this theory would caution against giving amounts of water exceeding

metabolic requirements or rates of metabolic utilization If the state of sodium metabolism is not known with absolute certainty before trauma, it probably would be unwise to give extra *sodium during trauma and convalescence* If sodium depletion or restriction has not antedated the traumatic episode, normal daily requirements for sodium can be given throughout operation and convalescence without fear of excessive retention and edema

Symptomatic Hyponatremia in Infants and Children Undergoing Surgery Herbert S Harned, Jr and Robert E Cooke[9] (Yale Univ) studied 6 children with severe symptoms due to hyponatremia postoperatively Four exhibited symptoms and signs of water intoxication, such as drowsiness, confusion, weakness and in-co-ordination, stupor, recurrent convulsions blurring of optic disks, retinal hemorrhages, moderate blood pressure elevation and convulsions resistant to barbiturate, 3 recovered without residual symptoms despite severe and prolonged convulsions One infant died, probably not directly as a result of the lowered sodium concentration Two patients had signs of myocardial dysfunction with cardiac decompensation and laboratory evidence of potassium intoxication in association with low serum sodium concentration Both were young infants with cyanotic congenital heart disease who had been exposed to prolonged and difficult cardiovascular surgery and anesthesia Cardiac failure appeared 24 and 36 hours after surgery Slow heart rates with regular rhythm associated with generalized weakness were observed in both

Excessive water intake parenterally or orally in the presence of antidiuresis was probably responsible for the water intoxication and sodium depletion probably caused the limitation in potassium excretion Knowledge of the sodium chloride, carbon dioxide, nonprotein nitrogen and protein concentration and renal concentrating ability permit correction of alterations in body composition before elective surgery Such studies should be performed preoperatively on all patients with previous central nervous system disorders or with recent limitation of salt intake

Similar chemical analyses should be done on all infants within the first 12 hours after surgery and repeated at 24 48

(9) Surg Gynec & Obst 104 543 550 May 1957

hour intervals, depending on the clinical course of the patient Any patient manifesting marked irritability, convulsions or coma postoperatively should be studied without delay to rule out hyponatremia as the cause of symptoms Likewise, the ECG may show the presence of hyperpotassemia whenever heart failure appears in this period

If hyponatremia occurs postoperatively, as it often does without any clinical effects, the treatment must be guided by the clinical status of the patient Avoidance of excessive water intake by these patients is all that is required If there are severe central nervous system symptoms, the serum sodium concentration should be elevated by giving 3% saline If severe symptoms of hyperpotassemia occur, elevation of the sodium concentration by the administration of hypertonic saline or sodium bicarbonate solution containing glucose with or without supplementary calcium or insulin may produce dramatic improvement

Fluid and Electrolyte Therapy in Surgery of Infants and Small Children is discussed by *Thomas G Baffes*[1] (Children's Mem'l Hosp, Chicago) Fluid and electrolyte calculations should not be applied without being evaluated as to daily weight, temperature, intake and output changes and periodic examinations of the blood and urine

The minimum total per diem fluid requirements in infants and small children is usually set at 60 cc/lb body weight (100 150 cc/kg) In severe dehydration, the amount should be increased to 90 cc/lb/day Fluid requirements decrease with advancing age and, above 100 lb body weight, children can be managed safely by adult formulas In the newborn no parenteral fluids are given for the first 48 hours after birth, then total fluid intake is limited to 45 cc/lb/day

If blood is transfused rapidly by a syringe, the amount given at one time is limited to 10 cc/lb, to avoid overloading the circulatory system Gravity drip transfusions are limited to a maximum of 30 cc/lb/day in infants and small children In children over age 3 or over 50 lb in weight about 5 cc/lb/day constitutes the maximum amount of blood that can be given in the absence of hemorrhage or shock It must always be kept in mind that blood and plasma participate in electrolyte metabolism and should be considered

(1) S Clin North America 36 1453 1463 December 1956

as saline in the patient's fluid and electrolyte calculations Plasma is considered equivalent to saline, volume for volume The "saline equivalent" of blood is only half the volume transfused because of the presence of cellular elements which necessarily remain within the intravascular system The saline requirement for daily maintenance has been set at 10 cc /lb /day for children under 50 lb and 5 cc /lb /day above 50 lb body weight

Often, when the patient first comes under observation, it is impossible to obtain accurate data on the amount of fluids and electrolytes he has lost An estimate of how many electrolytes to give him can be obtained from the CO_2 combining power and chloride values of his initial blood chemistries The following formulas are used

(1) For correcting chloride deficit
Normal serum Cl — observed serum Cl = mEq Cl deficit/L (or kilogram) of patient
Cl deficit × 0 7 × wt (in kg) = total mEq Cl deficit
(2) For correcting CO_2 combining power
Normal CO_2 — observed CO_2 = CO_2 deficit or excess
CO_2 deficit or excess × 4 2 × wt (in kg) = number of cc sodium lactate or ammonium chloride needed for correction

The attending nurses are given detailed instructions by the physician concerning the rate at which fluids are to be administered, e g , drops/minute and cc /hour Only small amounts of fluids are attached to infusion sets, usually never more than 250 cc at a time It is therefore impossible to administer lethal doses of fluid or electrolytes through the inadvertent release of the mechanism controlling the rate of flow

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WOUNDS AND WOUND HEALING

Flash Burns from Atomic Weapons I Observations on Flash Burning of Human Subjects in Laboratory Using Infra-red and Predominantly White Light Sources W J H Butterfield F R Drake Seager J R B Dixey and E E E Treadwell[2] (London) undertook laboratory studies of flash burns in man trying to assess the range of such injuries from atomic explosions and to study their clinical course and healing time

(2) Surg Gynec & Obst 103 655 665 December 1956

Preliminary trials revealed a need to test the influence of the area of skin exposed on the thresholds for pain, erythema and blister burning This test was made by using a gas-fired radiant panel as source Effects of high intensities of infrared radiation falling on the skin of the forearm in 1 second were studied in 8 male volunteers The threshold intensity for pain and for erythema (1st degree burns) was found to be greatly influenced by the size of the aperture used for exposures, but this wide variation did not obtain for shallow blister burns The median effective dose for shallow blister burns was 2 calories/sq cm

Further studies were undertaken with a stable carbon arc source of more realistic spectral qualities than the radiant panel It was found that 2, 3 5, 4 8 and 5 25 calories of predominantly white light radiation falling on the skin in less than 0 5 second produced erythema, shallow blister, deep blister and whole-skin-loss flash burns, respectively The healing time to be expected for uninfected flash burns from 3, 4 and 5 calories of predominantly white light would be 8, 15½ and 25 days, respectively

Because of the curvature of the body, 3d degree burns would in turn be surrounded by areas of 2d and 1st degree burning Since there would be an additional area of flaring, judgment of the extent of flash burning would be complicated Flash burns when first seen probably would be masked by other effects arising from the attack The blast wave would reach flash-burned casualties some time after they were burned The burns would almost certainly be soiled by dust thrown up by the blast wave Lacerations, contusions and abrasions might be superimposed To facilitate recognition and diagnosis of flash burns, it is desirable to cleanse them In mass casualties, provisions for so doing should hasten sorting and disposal of the patients

Comparison of Local and Systemic Effects Following Contact and Flash Burns Unprotected persons exposed to an air burst within the lethal radius for ionizing radiation would be subjected to overwhelming blast and thermal effects Beyond this lethal radius, many potential survivors would have severe physical and thermal trauma combined with sublethal doses of ionizing radiation Such patients would probably benefit most from therapy To study the effect of such trauma, James W Brooks, B W Haynes, Jr , W T Ham Jr , Fred

Schmidt and Ray Williams[3] (Med College of Virginia) studied the response of dogs to a 20% deep, 2d degree flash burn delivered in 1 second, a 20% burn delivered in 3 seconds, 100 r whole body irradiation, a 20% flash burn combined with 100 r whole body irradiation, combined with trauma, and the combination of burn, irradiation and trauma treated with penicillin

In dogs, flash burns of the same apparent depth of destruction as contact burns are less severe clinically, show less gross suppuration and heal more quickly, apparently because of the thick, hard eschar which protects the raw undersurface There was no difference between flash burns delivered in 1 second and those delivered in 3, contrary to findings in human volunteers in which a decrease in exposure time with the thermal dose held constant, caused more severe burns The over all clinical approach to flash and contact burns will apparently be the same

Whole body irradiation alone produced only a decrease in white blood cell count Clinically, the dogs showed no illness When a 20% deep, 2d degree burn was added, 11 of 30 dogs died in 6 days of overwhelming septicemia No significant change or difference was found in the wounds of animals living long enough to complete wound healing as compared with dogs which had not received radiation The rate of healing and gross appearance of the burns were the same Eight dogs were given the same treatment, but also received 900,000 units of penicillin intramuscularly, daily, beginning the day after trauma Only 1 animal died This study was not intended to determine optimal therapy, but to ascertain local factors which influence wound healing The major deleterious effect is invasion of body tissue and the blood stream by bacteria, secondary to the burn trauma

Report of Surgical Repair in First Group of Atomic Radiation Injuries is presented by James Barrett Brown and Minot P Fryer[4] (Washington Univ) Atomic injury (without thermal injury) affected 4 men while handling radioactive materials which emitted beta and gamma radiation amounting to about 10 r Conservative treatment was carried out successfully in all patients for the first 3 months Areas

(3) Ann Surg 144 768 777 October 1956
(4) Surg Gynec & Obst 103 1 4 July 1956

were resected and resurfaced with free thick-split grafts and good function resulted in all, no fingers were removed and all patients were able to return to full employment After 8 years no serious changes occurred and no deep losses have been noted The patients have been urged to protect themselves, and they will be watched closely for any subsequent changes that may need removal and grafting Any possible deep vascular damage should be recognized early and guarded against by urging avoidance of chemical, radiation, mechanical or other trauma

These patients indicate that local injuries (without thermal injury) caused by atomic radiation can be corrected surgically and successful rehabilitation is possible

► [These observations demonstrating that successful reparative surgery may be done after atomic radiation injuries are highly significant In light of the potentialities of this problem, they deserve emphasis —Ed]

Influence of Burn State on Turnover of Serum Proteins in Human Subjects Previous reports indicate increased rates of catabolism in patients with severe burns in whom equilibrium is not re established until late in convalescence Truman G Blocker Jr, William C Levin, John E Perry, Stephen R Lewis and Virginia Blocker[5] (Univ of Texas) intravenously administered S^{35} -labeled l methionine to normal hospitalized control subjects, nutritionally depleted patients and patients with mild and severe burns

No correlation was found between half times of the initial transfer phase of newly synthesized protein from the intravascular to the extravascular compartment in normal and burned patients Burned patients had normal or increased rates of protein anabolism, demonstrated by the amount of S^{35} incorporated into serum proteins and excreted in the urine The apparent catabolic phase was significantly shorter in severely burned patients

The results indicated patients with burns have an extra vascular pool relatively larger than the intravascular pool Since blood volume and total serum protein concentration are normal, the size of the total protein pool is probably normal The differences between half-times of normal and abnormal patients and the differences between the percentage of the injected dose of S^{35} taken up at the peak are probably valid Therefore, the apparent turnover of plasma proteins

(5) A M A Arch Surg 74 792 799 May 1957

in the burn patient is faster than normal, and anabolism is normal or accelerated, depending on individual clinical variations

Disappearance of Red Cells in Patients with Burns J W L Davies and E Topley[6] (Birmingham, England) estimated the red cell volume of 71 patients with burns During the first 12 hours after the burn, on average the red cell volume fell to only 12% below normal During the 13-48 hours after the burn, there was a loss of both transfused and patient's red cells which was sometimes considerably greater than the earlier decrease, particularly in extensive burns When these latter cases are included, the red cell volume fell on average to 30% below normal From the third day to operation, a further fall occurred in red cell volume of a variable degree—on average about 1%/day

The average relative fate of transfused group N blood within the total red cell mass of the peripheral blood in 49 patients approximated to the normal 1%/day The curve of concentration of radioactivity within the red cell mass was followed in 9 patients after labeling transfused, patient's or a mixture of cells with Cr^{51} Results fluctuated around the curve reported for normal persons This relatively normal fate of transfused red cells and patient's red cells within the red cell mass suggests that both patient's and transfused cells are involved in the fall in red cell volume that occurs between the burn and operation

Mortality of Burns at Massachusetts General Hospital was investigated by Benjamin A Barnes[7] Among 949 burns treated 164 were nonfatal and covered less than 1% of the skin area These were excluded from further studies To evaluate the mortality of the burns a series of 785 patients with an over all mortality of 11% was divided according to age groups and extent of burn The table presents crude data in these groupings This figure is in part a reflection of the distribution in the series of major and minor burns and is of descriptive significance only

The favorable upward trend of the mortality rates in the 2d age group is a reflection of the vigor and physiologic fitness of persons in the prime of life This group is in the best

(6) Clin Sc 15 135 148 February 1956
(7) Ann Surg 145 210 222 February 1957

condition to respond to careful and detailed therapy based on the application of biochemical and physiologic principles

The relatively good results noted in burns of 25-30% extent in the youngest age group in comparison to similar burns in the age 16 35 group is a consequence of the severe scalds oc-

PERCENTAGE OF AREA BURNED

Age in Years		1-4	5-14	15-24	25-34	35-44	45-54	55-64	65-74	75-84	85-94	95-100			Grand Totals
	Patients surviving	85	89	23	8	2		0	0	0	0		207		
	Patients dead	0	0	0	1	2		1	2	1	3			10	
0-15	Total	85	89	23	9	4		1	2	1	3				217
	Mean age	5.3	4 8	2.8	3.3	4 8		7	5	5	3		4 7		
	% mortality	0 0	0 0	0 0	11 1	50 0		100	100	100	100				
	Patients surviving	98	74	20	9	6	0	1	2	1		0	211		
	Patients dead	0	1	2	2	1	2	0	1	0		1		10	
16-35	Total	98	75	22	11	7	2	1	3	1		1			221
	Mean age	25	25	26	27	25	32	20	27	28		26	25		
	% mortality	0 0	1.3	9 1	18.2	14.3	100	0 0	33.3	0 0		100			
	Patients surviving	80	76	21	10	3	2	0	0	0		0	19?		
	Patients dead	0	3	1	1	3	6	6	4	2		1		27	
36-55	Total	80	79	22	11	6	8	6	4	2		1			219
	Mean age	45	45	45	42	41	44	45	39	44		52	45		
	% mortality	0 0	3 8	4 6	9 1	50 0	5 0	100	100	100		100			
	Patients surviving	31	39	18	1	0	0	0	0	0	0	0	89		
	Patients dead	4	2	8	3	3	6	4	2	3	3	1		39	
56-100	Total	35	41	26	4	3	6	4	2	3	3	1			128
	Mean age	66	65	71	70	6(	0	4	4	74	65	67	68		
	% mortality	11 4	4 9	30 8	75 0	100	100	100	100	100	100	100			
	Grand total of patients dead	4	6	11	7	9	14	11	9	6	6	3		86	
	Grand total of patients	298	284	93	35	20	16	17	11	7	6	3			85
	Group % mortality	1.3	2 1	11.8	20 0	45 0	87.5	91	81.8	85 7	100	100			11 0

curring in the younger group, whereas in the older group a deeper type of burn with fire and flume produces a more hazardous injury

A decline in mortality of about 5% followed the introduc tion in 1943 of adequate intravenous therapy, transfusions, antibiotics, improved methods of aseptic care, greater atten tion to nutrition, early excision, grafting procedures, etc However, even with improved treatment methods, the extent of burn and age of patient remain the major considerations in determining the prognosis In this series the advances in therapy since 1942 altered the issue of life and death in less than 1 patient in 10 The modest reduction in the over all mortality was shared by all burns, not only the more severe ones

Management of Burns is discussed by Michael L. Mason and John L. Bell[8] (Northwestern Univ.) Treatment of burn shock should be directed toward restoration and maintenance of an effective circulating blood volume The danger of burn shock remains for about 48 hours Thirst, restlessness and vomiting usually indicate need for more vigorous intravenous therapy The clinical response of a patient in burn shock is often more sustained with the use of whole blood If the burn covers more than 20% of the body surface and the trip to the hospital will require several hours, an intravenous plasma expander should be begun before transport of the patient On hospitalization, intravenous fluids should be started at once A Foley catheter should be introduced into the urethra, and the first urine specimen withdrawn for examination, thereafter urine should be measured each hour In the average-sized adult an attempt should be made to obtain a urinary output of 25-50 ml /hour during shock

The initial care of the burned surface should be directed toward avoiding infection Local treatment of the acutely burned wound consists of cleansing, removal of loose tags of tissue, vesicles and debris and application of a suitable covering over the burn surface Anesthesia is not used in initial care of burned surfaces because of the risk of precipitating or aggravating shock For sedation morphine may be given intravenously in small doses

The surgeon and his associates should check the integrity of the dressings daily Loose dressings cause mechanical irritation of the burn and constricting dressings are not only uncomfortable but aggravate edema formation distally After the patient s general condition has stabilized the dressings initially applied are carefully changed down to the layer of fine meshed gauze adjacent to the burned surface Burns of the face are usually inspected at the end of 48 72 hours, whereas dressings on burns of the trunk and extremities are changed 4 7 days after the burn

In most extensively burned patients, the surgeon can determine the area of whole thickness destruction of skin by the 10th day after injury *A plan for preparation* of the burn for skin grafting must then be outlined Necrotic tissue must be removed to prepare the surface for acceptance of grafts

(8) M Clin North America 40 1503 1513 September 1956

Burns which have a thick eschar are suitable for surgical excision, but facial burns rarely require excision because of rapid spontaneous separation of the slough. Thick eschars on the trunk or extremities take too long to separate spontaneously and should be excised Many whole-thickness burns of lesser depth are prepared for grafting by frequent application of moist compression dressings, using Dakin's or saline solution to soften the necrotic tissue Most burns should be prepared for skin grafting, at least for initial grafting, 15-18 days after injury.

Autografts are essential for permanent coverage of whole-thickness skin losses However, in extensive burns, homografting may be lifesaving if the patient's general condition is too critical for autografting or if donor sites for autografts are not yet suitable when areas of whole-thickness loss are ready for grafting If multiple grafting procedures are necessary to complete closure of the burn, extreme care should be taken to obtain thin grafts (0 012-0 014 in) which leave a donor site that heals rapidly Donor sites should be ready for reuse in 2-3 weeks If, after procurement of autografts, the patient's condition does not permit continuation of anesthesia, the grafts may be preserved at refrigerator temperature up to 3 weeks In extensively burned patients, certain areas should take precedence in application of available skin grafts Raw surfaces over joints, hands, feet, ears and face should be covered with skin as soon as possible Wherever skin is applied, the direction of the graft should parallel natural skin creases, particularly over joints In covering large areas with grafts, it is not necessary to suture the grafts in place If pressed firmly against the raw surface, the grafts soon adhere and carefully applied compression dressings hold them on the surface The dressing should be changed at the end of 4 5 days, since secretion at the borders of the defect may undermine the grafts

All patients with burns should receive adequate protection against tetanus In severe burns, penicillin is a useful adjunct Following burn shock, the patient should be placed on a high-protein, high-calorie and high-vitamin intake Vitamin C up to 1 5 Gm daily is necessary , other vitamins should be given in therapeutic doses

Early Management of Burns is discussed by William H

Amspacher[9] (Greenville, S C) Emergency therapy of burns consists of local treatment of the wound and prevention and treatment of shock When dressing therapy is used, the dressing should afford a mild degree of even pressure, be occlusive and be protective by somewhat limiting motion Whether any medication is required or even desirable beneath the dressing is doubtful Exposure therapy allows a natural protective covering to develop in the form of coagulated exudate, which forms a dry, relatively impregnable, crust in the case of the partial-thickness burn or the eschar of the full-thickness burn Face burns do not require dressing Whether dressing or exposure therapy is used, treatment of the burn surface will be much the same There is no longer need for debridement, only the most gentle cleansing with mild soap and water or saline solution is necessary Blisters may or may not be broken General anesthesia is contraindicated A small dose of Demerol* intravenously usually will control pain

As a lifesaving procedure, treatment of burn shock, by providing an adequate amount of blood, fluid and electrolytes to replace what has been lost as a result of the burn, takes precedence over wound treatment Urinary output is an excellent index to the adequacy of fluid therapy, for this reason, an indwelling catheter must be inserted During the first 48 hours urinary excretion in the adult should be kept in the range of 30-50 cc /hour Any burn of over 50% of the body surface should have fluids calculated on the basis of a 50% burn to prevent overtreatment Usually, 10,000 cc fluid in the first 24 hours is the maximum required A simple fluid formula calls for 1 cc of colloid or electrolyte solution/lb body weight for each per cent of the body burned Of the total calculated fluids 30-40% is ordinarily colloid solution, the remainder being electrolyte If a 175 lb adult has deep burns to 40% of the body surface the fluid plan should be as follows

$40 \times 175 \times 1 = 7{,}000$ cc of electrolyte and colloid

Colloid = 40% of 7 000 cc	=	2 800 cc	
(Converted to units of 500 cc)	=		3 000 cc
Blood		500 cc	
Dextran		2 500 cc	
Electrolyte solution	=		4 000 cc
(7 000 3 000)	=		1 000 cc
5% dextrose in H_2O	=		1 000 cc
Oral H_2O			
Total fluids for first 24 hours			

(9) S Clin North America 36 1385 1394 October 1956

Respiratory burns should always be looked for in patients who were burned in a closed space, such as an automobile or a room with windows shut

Tetanus antitoxin or toxoid must be given routinely Though infection seldom is obvious in the early phase of a burn, prophylaxis with penicillin is essential

Therapy of Severely Burned Patients: 11 Years' Study at the University of Minnesota is reported by Claude R Hitchcock and Samuel Horowitz[1] in 170 patients Serious burns are often fatal Where 55% or more of the body surface is severely burned, mortality is as high as 85% in most clinics The patient is usually carried through the initial "shock" by fluid and electrolyte therapy, only to succumb to sepsis, hepatic failure, cardiac complications or other medical emergencies Earlier, more complete grafting of larger burned areas must be done

Transport of patients with severe burns to hospitals where definitive care is available should not be delayed If skin grafting cannot be done in the local hospital, the patient must be transferred immediately to a proper center Ambulance transport is safe and comfortable if petrolatum gauze and bulky dressings are used on the burn The apathy inherent in treating a "chronic surgical problem" must be vigorously combated by all caring for these patients

Whole blood and plasma should be used in equal amounts for colloid replacement Colloid materials, 1 cc /1% surface burned/kg body weight should be given in the first 24 hours Saline solution in equivalent amounts should be used The hourly urine output is an effective measure of adequate fluid replacement The proper fluids should be administered immediately after the burn has occurred Infusion of these quantities of fluid requires caution in patients over age 50 and in those whose burns cover more than 50% of the body surface The aims of initial replacement therapy should be to compensate for the large abnormal losses and translocation of circulating fluid, electrolyte and protein, to prevent hyponatremia and undue concentration of the red cell mass and to maintain a slightly reduced level of serum sodium to help prevent pulmonary edema Diuresis from mobilization of the extensive interstitial edema fluid into circulating blood usually begins by the 30-40th hour after the burn Administered

(1) A M A Arch Surg 74 485-499 April 1957

fluids must be markedly reduced on the 2d day and thereafter, or hypervolemia and pulmonary edema can result Whole blood, enough to account for one-third to one half the initial colloid requirement, compensates for early loss of red cell mass and combats shock Untoward hemoconcentration does not result from this therapy If omitted, anemia of varying severity results In the later stages of therapy, during reconstructive surgery, whole blood is essential

In treating the burned area itself, the completely open method without initial debridement or cleansing of the area is most valuable About 3 weeks after injury, when the eschar begins to separate spontaneously from the deeper, viable tissue, *debridement and immediate grafting with homo and autografts* is undertaken

Daily caloric requirements are far in excess of normal to offset the inordinate chronic depletion after a burn Severely burned adults require 4,000 5,000 calories daily Gavage supplements may be necessary A mixture of pureed meats and vegetables in homogenized milk and rich eggnogs made of cream and milk are better tolerated than protein hydrolysates Daily recording of caloric intake is essential and 1 day below required intake should cause concern

The over all mortality in the authors' series for patients with 3d degree burns of 15% or more of the body surface was 20 5% A significant number survived extensive burns 5 survived 40% burns, 2 50% burns 2 55% burns and 1 a 70% burn However of 10 patients with burns of 50% or more 5 died

Infection Major Unsolved Problem in Severe Trauma Curtis P Artz and Paul E Teschan[2] (Brooke Army Med Center) report that improved resuscitative therapy in burned patients or in patients with severe mechanical trauma has resulted in longer survival but that eventually infection has caused death in many Patients with post traumatic renal insufficiency have been sustained by proper fluid electrolyte therapy and multiple dialyses with an artificial kidney through diuresis and chemical recovery only to die later of infections

Of 1 000 burned patients treated between 1950 and 1956 82 died Septicemia was associated with death in 46 and in

(2) Am J Surg 93 [illegible] April 1957

proper replacement therapy in 10 Total percentage of burn in patients who died averaged 56%, 40% had 3d degree burns The causative organism was primarily a resistant form of Micrococcus pyogenes Total percentage of burn in 9 patients who survived septicemia was significantly less than in those who died Because many of the causative organisms were sensitive to bacitracin, it was given daily in doses of 300,000 units, and permanent renal damage was not seen in any patient so treated

Of 24 patients with acute tubular necrosis, 7 survived Of the 17 who died 12 had a severe infection and 8 of these had diuresis

The problem of infection after injury is a compound one Resistant organisms may develop and the insult from the injury may be so severe that the body's defense mechanisms are incapable of withstanding the attack by bacteria Further studies are indicated concerning resistance of the body to infection

Outbreak of Staphylococcic Infection in Surgical Ward in which a male and female unit and operating theater were located, is reported by R A Shooter, J D Griffiths, Josephine Cook and R E O Williams[3] During 7 weeks, 86 clean operations were performed Three patients died of causes unrelated to sepsis Of the other 83 patients, sepsis developed in the wounds of 24, 18 were in the male ward Staphylococcus pyogenes was cultured from 17 infected wounds In 7 men, staphylococcic infections developed at sites other than the operative wound there were 5 chest infections, 3 urinary *infections and 3 instances of staphylococcic enteritis* Because of the prevalence of infection, operations were stopped and the male ward closed

The isolated staphylococci were resistant to streptomycin and tetracycline, but at first were sensitive to chloramphenicol and erythromycin Later, as a result of treatment, variants resistant to these drugs appeared The staphylococci causing the enteritis and chest and urinary tract infections were plainly acquired in the ward

Nasal swabs were taken from all members of the operating teams and from 7 of these swabs, Staph pyogenes was recovered, but from only 1 was the epidemic type isolated

(3) Brit M J 1 433-436 Feb 23 1957

Examination of this person's activities strongly implicated him in the epidemiology. Of 45 patients in whose operations he participated, 21 became infected; of the 38 operated on in his absence, none had a staphylococcic infection. On three occasions the carrier was examined after he had been wearing rubber gloves. His hands were moist, and staphylococci of the epidemic type were recovered from the fingers and inside of the gloves, even after preliminary washing with soap, water and scrubbing brush. Staphylococci could be isolated from the air when he was shut in a sterile room in his ordinary street clothes.

Undoubtedly, some wounds were infected at operation, probably via glove punctures of the carrier. About a third of the gloves worn by members of the surgical staff have perforations after use. Some ward infections may have arisen from a nurse who was also found to carry the epidemic strain of staphylococci and from a lung abscess in 1 patient. The epidemic strain was found in quantity in the air and on bedclothes, curtains and other items. Measures taken to disinfect the male ward were successful. Staphylococci were eliminated for a time and the incidence of infection reduced.

Prevention and Control of Postoperative Wound Infections Owing to Staphylococcus Aureus is discussed by Chester W. Howe[4] (Boston). Late in 1953 and early 1954 various measures to prevent cross contamination and dissemination of antibiotic-resistant bacteria were started at Massachusetts Memorial Hospitals. First, use of antibiotics was reduced, being limited to treatment of established infections—not for mere presence of bacteria in nontuberculous infections. Staphylococcic infections were treated with an appropriate combination of antibiotics. Simultaneous and continuous use of two drugs lessens the chance for emergence to predominance of pre-existing resistant mutants.

Because the nasopharynx is the natural reservoir for staphylococcus and the carrier rate for this organism was high, two face masks (one over the other) were worn during operations and changed by the circulating nurse every 1½ hours in long procedures. A full 10 minute surgical scrub with a G-11 soap was advocated.

In wards, masks were used by doctors, nurses and patients. During change of septic dressings gloves were worn by per-

(4) New England J. Med. 255:787-794, Oct. 25, 1956.

sonnel Special septic sets were used, with necessary instruments in an aluminum pan covered by a large, sterile, double-ply cloth wrapper Each set was accompanied by a mask, sterile gloves and a large, waxed paper bag for immediate disposal of soiled dressings Bags were deposited in a closed container and contents burned daily The set was unwrapped at the patient's bedside When the dressing was finished, instruments, gloves and other contaminated equipment were deposited in the pan, which was then rewrapped and sent for autoclaving before cleaning and definitive sterilizing

Early control of the infection is one important way to prevent spread of resistant organisms Conversion of an infected wound into a clean one by immediate drainage and debridement is practical and safe under proper antibiotic protection and allows early secondary closure and discharge from the hospital However, immediate drainage and debridement are contraindicated in elderly or debilitated patients, when additional anesthesia would be more hazardous than ravages of sepsis, in less serious infections that can be controlled in shorter time by conventional methods and in certain anatomic situations where proper obliteration of dead space at time of secondary closure would not be possible

Howe reviewed the rate of clean wound infections at Massachusetts Memorial Hospitals for 1949-55 A gradually increasing infection rate during the 5 years before 1954 is attributed largely to a high hospital carrier rate of penicillin resistant Staph aureus as a result of widespread use of penicillin

During the last 2 years, the hospital carrier rate of Staph aureus and incidence of penicillin resistant strains in carriers were significantly lower, rate of postoperative wound infections was reduced by almost half since start of a program for prevention of cross contamination and judicious use of antibiotics

► [The emergence of resistant strains of Staph aureus has created a serious problem of wound infections in many hospitals As indicated by Dr Howe strict aseptic technic including the control of carriers in the operating room and during the postoperative period of wound care remains the sine qua non for prevention of wound infection Antibiotics are valuable adjuncts when indicated but their indiscriminate use 'prophylactically in clean wounds is to be deplored —Ed]

E Clifton[5] (New York) treated chronic surgical wounds and sinuses with a combination of plasmin and hyaluronidase. Of 31 patients treated, 7 had abscesses of the breast, 3 had persistent sinus tracts opening into large cavities, 6 chronic smaller sinus tracts and 15 open granulating wounds

The materials applied were (1) streptokinase-streptodornase (SK-SD) mixture (Varidase®)—100,000 units SK and 25,000 units SD dissolved in 10 cc distilled water, (2 plasminogen (profibrinolysin), prepared from fraction III of human plasma—35 mg powder dissolved in 1,000 ml water, with 10 cc of this solution activated with 0 5 cc SK-SD mixture, (3) hyaluronidase, 150 turbidity-reducing units/ml, (4) oxytetracycline (Terramycin®), 25 mg/ml, (5) bacitracin, 500 units/ml

TECHNIC—The wound was irrigated with a saline solution to remove loose debris Freshly-prepared enzyme solutions were instilled into the wound after the patient had been placed in a suitable position to assure adequate contact of the materials with the wound surfaces Then, sterile gauze saturated with the enzyme solution was packed into the wound Petrolatum gauze was placed over this packing as a seal and reinforced with dry sterile dressings Immobility in the position of choice was limited to 20-30 minutes, the patient then was ambulated Initially, these dressings were used one or two times daily As the wounds became cleaner, treatments were reduced in some patients to one or two a week

Plasmin (fibrinolysin) was used for the initial debridement When the granulation tissues were clean and pink, hyaluronidase was added to the plasmin or used alone Sometimes an antibiotic solution was added to the enzyme mixture in a ratio of 1 1

Results showed hastening of wound cleansing and healing The method was simple, treatment safe No complications were proved to be due to the enzymes Earlier closure of these chronically infected wounds and earlier discharge of patients from the hospital were effected When antibiotics were added there was no material improvement in wound cleansing or healing, compared with the use of enzymes alone

Enzymatic Debridement of Wounds: Preliminary Report A Gibson Packard, Jr[6] (Univ of Maryland) used papain a proteolytic enzyme, for surface debridement Irrespective of the site of the lesion to be debrided, the following procedure was used

(5) Am J Surg 92 496 506 October 1956
(6) Am Surgeon 22 543 548 June 1956

TECHNIC.—The patient was examined initially and the extent of devitalized tissue evaluated. If necrotic tissue could be debrided mechanically, this was done. The area was then flushed with 3% hydrogen peroxide and allowed to dry. A piece of gauze, about the size of the affected area, was applied to the wound and soaked with papain solution. The amount used for each particular patient varied with the size of the area. The piece of gauze then was covered with a thin transparent waterproof plastic material to prevent drying by evaporation or diffusion. This was, in turn, covered by dressings, and all were held in place by adhesive tape or elastic bandage. The dressing was not disturbed, as a rule, for 24 hours. After that, the wound was examined once again. Any loose necrotic tissue was removed and the process repeated. Patients were treated daily until complete debridement and a healthy granulating wound were obtained, or until treatment had to be discontinued for some unforeseen reason.

Papain appears to be an excellent and efficient agent for topical enzymatic debridement. There was no delayed granulation or visible evidence of irritation of adjacent normal skin. However, several patients noted a pruritic sensation in the skin surrounding the area under treatment, and in 2 patients this symptom was so annoying that treatment was stopped. No skin changes were seen. It is suggested that application of petrolatum jelly to the adjacent skin might be sufficient protection against this symptom when it is annoying. Aqueous Zephiran® rather than 3% hydrogen peroxide as a cleansing agent is also suggested to eliminate oxidative inhibition of enzymatic activity.

► [The difficulties of studying this problem with adequate controls has long been well known and is recognized by the author, who admits that "it is possible that the improvement of the infection in these wounds is the purely mechanical effect of the removal of a good culture medium from the cavity." Only time and the accumulation of considerable experience may determine the value of enzymatic debridement, but so far the evidence has not been impressive.—Ed.]

Current Evaluation of Antibiotics in Surgery is presented by William A. Altemeier[7] (Univ. of Cincinnati). Experience has proved that antibiotic therapy should be used primarily in surgical practice as a supportive or adjunctive measure to the indicated operative procedure. Prophylactic use of antibiotics can be of value under the following conditions: elective surgery performed in contaminated or infected areas, such as the gastrointestinal, respiratory or genitourinary tract; contaminated wounds of violence; when an indwelling catheter is necessary; in patients with derangement of the

(7) Postgrad. Med. 20:319-323, October, 1956.

urinary tract; emergency operations in the presence of associated and unrelated infection, such as acute upper respiratory infection; injuries or operations of oral and pharyngeal cavities in patients with pre-existing heart disease, and, probably, operations on elderly patients with pre-existing pulmonary disease. In these instances one should choose the antibiotic agent on the basis of anticipated or known bacterial flora and should administer it systemically and early.

Evidence suggests that patients who have undergone trauma and have contaminated wounds should be given the aqueous type of penicillin G, not the procaine If there is shock or impending shock, penicillin should be administered intravenously and not intramuscularly.

When there is gross contamination by fecal bacteria, use of aqueous penicillin intravenously should be augmented by intravenous injection of 500 mg. chloramphenicol, tetracycline, chlortetracycline or oxytetracycline This should be repeated at intervals of 8-12 hours for 72 hours. After that, further use of these agents should be critically re-evaluated

Infections respond best when they are in the diffuse or cellulitic stage, when the infected area still has an intact blood supply and when bacteria are growing at an extremely rapid rate Under such circumstances the effect of the antibiotic agent is greatest and is usually followed by prompt regression of infection and spontaneous resolution without abscess formation or necrosis of tissue

If a patient with septicemia does not show marked and definite response within 72 hours, the treatment may be based on the wrong etiologic agent, an obscure abscess or a secondary complication may exist which has not been recognized, a superimposed infection has developed or a vegetative endocarditis, either of the right or left heart, is present

The timing of surgical intervention in patients with surgical infections is of utmost importance In many instances, emergency radical decompression is necessary within an hour or two after onset of therapy, in others it is possible to delay surgery for a day or two until the patient's condition can be improved It is inexcusable to treat a patient with antibiotics for weeks or months to forego surgical treatment which could cure him in a week or 10 days

► [In light of the common abuses of antibiotic therapy, so often applied routinely and empirically this article by a thoughtful and critical observer who has devoted much attention to this problem deserves emphasis —Ed]

Actinomycosis · Its Recognition and Treatment John Collins Harvey, James R Cantrell and A Murray Fisher[8] review records of 37 patients with actinomycosis treated at Johns Hopkins Hospital during the last 25 years Abdominal tissues were the sites of primary lesions in 23 (63%), cervicofacial tissues in 9 (24%) and lungs in 5 (13%) There were 26 males and 11 females, 20 whites and 17 Negroes, aged 19 66

Before 1945, iodides were administered routinely and a few patients were treated with thymol Irradiation of actinomycotic lesions was tried in a few Occasionally, abscesses were surgically drained and treated as ordinary pyogenic infections Since 1945 all patients have received penicillin as specific treatment The standard practice is to give 10,000,000 20,000,000 units daily, intravenously in a continuous drip for 12 hours After 30-45 days of antimicrobial therapy, wide surgical excision of the infected tissue is done In lesions involving superficial structures, the wound is packed open and allowed to heal by secondary intention In visceral lesions, primary closure is effected After surgery, 2,500,000 5,000,000 units of penicillin is administered intramuscularly daily for 12-18 months

Among patients treated before 1945, 13 died and 5 lost to follow up showed progression of disease at last examination, 3 were listed as cured, 1 was followed for 10 years, 1 was well 2 months after discharge, but lost to subsequent follow up, 1 had infection in the tonsil crypts found at tonsillectomy Of 16 patients treated since 1945, 4 died and 12 were cured Since 1952, 9 patients have received initial massive penicillin therapy, wide surgical excision of infected tissue and long continued penicillin, 2,000,000 5 000,000 units daily for 12-18 months after excision, with a cure rate of 88% (follow up 6 months to 3 years) Although the 1 death must be considered a failure statistically, it was caused by uncontrollable bleeding due to thrombocytopenia developing subsequent to multiple blood transfusions

The cases reviewed support the concept of the endogenous origin of the infection The organisms, which normally inhabit mucous membranes, gain entrance to deeper tissues through a break in the mucous membrane Abdominal involvement was noted after rupture of gastric ulcers and after perforation of the colon by fish bones In three instances

(8) Ann Int Med 46 868 885 May 1957

fish bones were recovered from the abscesses at operation

Wound Healing: New Perspective with Particular Reference to Ascorbic Acid Deficiency. On the basis of experiments in guinea pigs, J Englebert Dunphy, K N Udupa and Leon C Edwards[9] (Harvard Med School) suggest that in protein-deficient animals there is a deficiency in the "building blocks" of repair, whereas in scorbutic animals these basic materials are present in adequate amounts but cannot be utilized until ascorbic acid is provided In protein depletion, adding a single amino acid, methionine, restores the pattern of hexosamine and hydroxyproline concentration toward normal Apparently methionine has some specific action in the healing wound

Normally by the 4th day, the wounds in guinea pigs reveal many immature fibroblasts invading the fibrin clot with well formed intercellular substance The hexosamine concentration is significantly higher in the wound than in the surrounding normal skin and subcutaneous tissue By the 8th day, many newly formed collagen fibers surround the fibroblasts and the collagen content is increased, accompanied by a decrease in hexosamine concentration By the 12th day, newly formed young collagen fibers are readily seen, a few reticular fibers are seen and mucopolysaccharide stains show little positive reaction

In the scorbutic animals on the 4th day, the wounds contain plenty of fibroblasts actively proliferating and invading the clots, similar to the activity in the normal wound The intercellular ground substance does not stain metachromatically, although the para-aminosalicylic acid and colloidal iron stains are positive The hexosamine concentration is less than in normal wounds By the 8th day, the fibroblasts are still actively proliferating and multiplying, but appear somewhat less well oriented than in normal animals and no collagen fibers are being laid down A large collection of reticular material is seen by silver impregnation stain which is thick and poorly oriented, occurring in globules rather than as fibers The collagen content is significantly less than normal By the 12th day, the fibroblasts are still immature, the hexosamine content is high and the collagen content low Since reticular material is presumably a precursor of

(9) Ann Surg 44 304 317 September 1956

collagen, and it is present in abundant amounts by the 8th day, this is interpreted as indicating that the protein precursors of collagen are not properly oriented toward collagen formation.

In ascorbic acid deficiency fibroplasia, mucopolysaccharide production and the formation of reticular procollagen material are not inhibited. The defect in repair apparently is of collagen synthesis and may be corrected within 24 hours after ascorbic acid administration.

► [These observations represent a refreshing approach and provide a new perspective to the age-old problem of wound healing. Further studies along these lines of investigation offer promise of much significance.—Ed.]

Abdominal Wound Disruption with Eventration: Report of 40 Cases. Among 11,334 laparotomies (excluding herniorraphies), Tirso del Junco and Henry J. Lange[1] (Los Angeles) found 40 instances of wound disruption (0.35%). Mortality rate was 17.5%.

No single factor accounts for all wound disruptions. Most appear to result from a combination of unfavorable influences. Occasionally, etiology remains obscure. Most writers emphasize the major or immediate causes of wound disruption as generally associated with marked increases in intra-abdominal pressure or severe muscular strains, with severe infection occasionally significant. There are several contributory factors, such as age, sex, constitutional diseases (obesity and chronic cough) and the primary disease. In the authors' patients, 70% of the disruptions occurred over age 50 and about 75% among men. The most frequent primary disease associated with wound disruption was carcinoma, especially of the colon.

In the authors' patients neither the type of suture material nor interrupted or continuous technics used significantly influenced incidence of wound disruption. Absorbable suture material was employed in 23 instances and nonabsorbable in 17. On the same order, interrupted or continuous technics were employed.

For prevention of wound disruption, anatomic incisions are preferable to nonanatomic or vertical incisions whenever possible, and though wounds heal from side to side, unduly long incisions are more likely to end in wound disruptions

(1) Am J. Surg. 92:271-286, August, 1956.

stant throughout life in Japan and do not show the increase after age 50 seen in English statistics. A search for possible reasons for the low breast and high uterine cancer mortality and for the low intestinal and high gastroesophageal cancer mortality in Japan might be helpful to the study of causation of these forms.

Influence of Splenectomy on Induction of Osteogenic Sarcoma in Rabbits was investigated by Joseph M. Janes, George M. Higgins and J. F. Herrick[5] (Mayo Clinic and



Fig 4 — Tumors of lower part of rabbit's right femur, upper right femur, upper right tibia, right ilium, right ischium and left ilium (Courtesy of Janes, J M, *et al* J Bone & Joint Surg 38 A 809 816, July, 1956)

Found) In an initial study (1952) they found that when beryllium silicate was given intravenously to normal rabbits osteogenic sarcoma was produced in 50% of the animals These tumors arose in the medullary cavities of the long bones and extended through the cortices into the surrounding soft tissues The spleen appeared to play some role in

(5) *J Bone & Joint Surg 38 A 809 816, July, 1956.*



tumorigenesis. In all these animals in which tumors developed, atrophic changes occurred within the spleen. In the animals in which tumors did not develop, the spleens were functional and hyperplastic.

In the present study, the authors gave zinc beryllium silicate to 11 healthy rabbits, following splenectomy. Three

animals died before enough time had elapsed for the production of osteogenic sarcoma In 7 animals, osteogenic sarcoma developed (Figs 4-6), while in the eighth new bone formation was found in the medullary cavity of the long bones at time of death *This condition appears to be the forerunner* of beryllium-induced osteogenic sarcoma in rabbits

The authors suggest that the spleen in a rabbit provides protection against development of beryllium-induced osteogenic sarcoma

Cancer in Twins: Twenty-Year Study on Unselected Twins O Frhr von Verschuer[6] (Univ of Munster) investigated 90 pairs of unselected twins (26 uniovular and 64 binovular), one or both of which had cancer Of 23 uniovular pairs, only 3 showed concordance regarding type or localization of cancer (gastric cancer) Of 54 binovular pairs, 12 showed concordance but only 2 had identically located cancer (stomach and breast)

When these data were added to the figures published in the literature, the proportion of concordance to discordance of cancer in 120 uniovular twins was 21 79 and in 287 binovular twins, 15 85, i e there was no significant difference Hereditary influence is apparent for localization of tumors in concordant pairs, but this influence appears to be present only for certain kinds of cancer, e g , of the stomach *It is suggested that there is a nonspecific inherited disposition* If persons with similar inherited disposition are exposed to different cancerogenic factors, the same cancer will develop in an area of the body where local predisposing factors are effective If this localized cancer disposition is inherited twins will have the same type of cancer with the same localization In binovular twins with different local cancer disposition the localization will be different

Host-Tumor Antagonism I Evidence for Existence of "Tumor Immunity" is discussed by Louis Pelner[7] (Swedish Hosp Brooklyn) Cancer may be defined as a new growth of cells autonomous in nature and serving no useful function Certain cancers are hormone dependent, although once started, they seem independent of the exciting cause their growth can be somewhat controlled Another method

(6) Deutsche med Wchnschr 81 1456 1459 Sept " 1956
(7) J Am Geriatrics Soc 4 683 689 July 1956

of control, tumor immunity, may some day be proved

It has been known since the beginning of the century that some immunity exists to transplantable tumors Gaylord and Clowes, in 1906, noted that a mouse that recovered from carcinoma could not be successfully inoculated again within a certain period This immunity could not always be successfully maintained in some animals, since some tumors remained stationary or regressed, but later overcame the host resistance and killed the animal The number of successful takes could be reduced if tumor material was mixed with the blood of the recovered mice

Lumsden believed he could demonstrate antimalignant cell antibodies He was able to produce antiserum in animals by injecting heterologous tumor tissues The immune properties of this serum could only be demonstrated in tissue cultures, because the serum could not reach the malignant cells in effective amounts in the intact animal Lumsden felt that slow regression of a tumor was essential to effect a cure and evoke immunity Absorption of antigenic material from the dying tumor acted like a vaccine and induced active immunity in the animal against the tumor concerned Similar experiments have recently been performed by others, with confirmation of his results

Kellock and his associates tried to immunize 12 patients against their own neoplasms, by removing the tumors, irradiating them with x-rays, and then injecting part of the irradiated tumor material into the patient Five patients died, but the rest were comparatively well at the time of the report However, these experiments were later controverted by Wood and Prigosen

Many modern observers agree that antibody production by the host after tumor inoculation does occur, but not after all inoculations and not in all animals even of the same strain The reason for this lack of uniformity is unknown Lewis and his associates showed in experiments that optimum conditions for development of immunity are that the tumor must actually grow in the host, it must die in the host, and the tumor tissue must degenerate under conditions that permit slow absorption of the degeneration products

Recently Graham and Graham demonstrated antibodies in human carcinoma by the complement fixation technic

using the patient's tumor as antigen and the patient's serum as the source of antibodies Significant titers were observed in 12 of 48 patients Those in whom antibodies developed showed lesions that were completely removable or could respond satisfactorily to radiation therapy Six patients had a significant titer after removal of the tumor In 18 of the 36 patients in whom antibodies could not be demonstrated, clinical outlook was unfavorable Serum from 25 controls gave only one complement fixation reaction with one of the tumors The Grahams felt that virulence of the tumor was less important than resistance of the host and that therapy should be governed accordingly

Spontaneous Regression of Cancer: Preliminary Report Tilden C Everson and Warren H Cole[8] (Univ of Illinois) studied the incidence and nature of spontaneous regression of cancer Of over 600 cases published or obtained by personal communication, the authors considered only 47 adequately documented as possible examples of spontaneous regression In 11 of the 47, regression was complete and verified by microscopic examination of tissues after regression, 4 were carcinomas of the bladder Factors responsible for the regression were thought to include endocrine factors, unusual sensitivity to inadequate irradiation or other therapy, fever and/or infection, allergic reactions, interference with nutrition of the tumor and removal of the carcinogen

Survival in Untreated and Treated Cancer is discussed by Michael B Shimkin, Matthew H Griswold and Sidney J Cutler[9] During 1935 51 among the 2,000,000 inhabitants of Connecticut 75,494 persons had cancer The 5 year survival gradually improved from 12% to 19% of all men and women, respectively, in 1935 40, to 20% and 32%, respectively, during 1947 51 This progress appears to be attributable to better treatment extended to a greater proportion of the patients However, the improvement is not due to earlier diagnosis as indicated from the similar distribution of localized and disseminated cases during the study period Improvement occurred in cancer which was diagnosed when clinically localized and when regional areas were involved, but not when the cancer was disseminated The most marked

(8) Ann Surg 144 366 383 September 1956
(9) Ann Int Med 45 255 267 August 1956

improvement was recorded for cancer of the colon and rectum in both sexes and of the uterine cervix in women

A new era lies ahead in early diagnosis of cancer The median age of women with in situ carcinoma of the cervix is 35 years Data on morbidity of cancer in 10 metropolitan areas has shown that the median age of women with localized but invasive cancer of the cervix is 49 7 years When cervical carcinoma involves regional structures, the median age is 52 8 years The age at death is 53 4 years This means there is a 15-year span between the time that cancer of the cervix should be practically 100% curable and the time that cancer should reach the invasive phase An accelerated growth rate is suggested, with an average of 3 years between the localized stage and the regional involvement stage and only another year until death The latent period of occult cancer of the prostate on the median is about 6 years and in younger age groups, approaches 20 years Similar facts may pertain to many other types of neoplastic disease Studies on the occult and in situ stages of cancer will lead to many revisions in concepts and treatment of neoplastic disease Instead of thinking in terms of 5 years, one is faced with situations in which 20 year spans should not be the limitation for considerations of the natural history of cancer in man and the effects of treatment thereon

Assessing Curability of Cancer is discussed by T W Lees[1] (Edinburgh) The difficulty in judging the value of treatment lies in the rigid and generally false conception held about cancer behavior that all neoplasms can be divided into benign and malignant, that all malignant tumors at any one site behave in a uniform manner and that untreated cancers are rapidly and invariably fatal The current concept of cancer is unacceptable because it is at variance with observed facts Much difficulty could be avoided if cancer were considered a local manifestation of a systemic degenerative disease Cancers arise through failure of the body as a whole to control growth More attention might be paid to factors which result in failure to control growth than to results of that failure—the discernible tumors

Even if the claim that excision of a premalignant lesion prevents a cancer death is accepted, such treatment will have

(1) Acta radiol supp 132 1956

a negligible effect on the over-all cancer death rate There is no harm in regarding the object of treatment as the diminution in the number of cancer deaths and not as the increase in the number of "cures" This objective is often forgotten in the competitive presentation of cure rates

The principal "cause" of cancer in human beings is aging, a search for specific "causes" is likely to prove barren in the foreseeable future, and hence the chance of "preventing" cancer is not great

The behavior of the host, i e, the behavior of all tissues other than malignant tissues, is of equal importance to that of cancer in determining the period of survival after overt tumor or tumors have appeared

Any method of assessing curability of cancer should, if possible, indicate the relative importance of any factor in the host, cancer or treatment which has played a part in hastening or delaying the patients' death

Because of the multiplicity of possible "causes," treatment at present is only of a nonspecific type A single chemotherapeutic substance which will specifically inhibit growth of most or all cancers (and have little or no effect on nonneoplastic tissue) is unlikely to be found Antibiotics are effective against a wide variety of organisms which possess a common (normal) enzyme system which can be inhibited But the same abnormal "malignant" enzyme system may never occur in two cancers since no two cancers are ever identical in behavior

Present Status of Surgery in Treatment of Cancer is discussed by George Crile, Jr [2] (Cleveland Clinic) Aside from improvement in cancer of the cervix, vital statistics on cancer show mixed trend, rising in cancer of the respiratory tract, inexplicably falling in cancer of the stomach

Cure of cancers that would not be fatal, even if untreated does not alter the cancer death rate Biologic predetermination is a factor in cancer Some cancers, like basal cell cancers, remain localized from the time they are clinically recognizable, whereas others, like melanomas, may spread into the circulation before the primary tumor is noticeable, presenting themselves as systemic disease

Surgery has two possible effects on cancer (1) Localized

(2) Postgrad Med 20 118 124 August 1956

cancers that are not yet widely disseminated may be completely eradicated (2) Even a localized cancer may be disseminated and implanted by operation and its course greatly accelerated, so that the patient dies much sooner because of breaking of the natural barriers of host resistance Even with localized gastric cancers, if they have extended through the wall of the stomach to involve the serosa, smears of peritoneal fluid or of saline washed over the peritoneal surface of the cancer often show cancer cells Ascitic fluid in patients with extensive cancer is filled with cancer cells Since Krukenberg's tumor occurs in ovulating women, the trauma of ovulation in which the peritoneum is broken, probably determines the site of implantation Similarly, some operations, even if only exploratory or for biopsy, may permit implantation of the cancer and its much more than naturally rapid growth

Not only cancer of the skin, but also cancers of various organs (stomach, breast) may have a wide spectrum of malignancy, comprising low-grade cancers that do not metastasize, middle-grade cancers which metastasize only to lymph nodes and not systemically and highly malignant types with wide, systemic spread

The challenge is clinical differentiation of one type from another Certain cancers of the breast, e g, inflammatory carcinomas, are not curable by operation Perhaps the infiltrating "leather bottle" cancer of the stomach is the gastric equivalent of inflammatory carcinoma of the breast and should not be operated on except to relieve obstruction In the serous cavities, harm is done by resection and dissemination of certain types of cancers not adaptable to surgical intervention Since the blood vessels of highly malignant cancers are filled with cancer cells, manipulation may liberate more cells The frequency of local recurrences following low anterior resection of cancer of the colon is now attributed largely to implantation of cells In more than 60% of all patients with low grade papillary carcinoma of the thyroid cut into or biopsied at operation, subsequent operation showed implants of the cancer in skin, subcutaneous tissue or muscle remote from the thyroid itself

The wisdom of routine removal of lymph nodes involved by cancer is questionable A lymph node may act as a barrier

to prevent spread of cancer, or if involved, as a source of further spread of the disease. It must be determined which lymph nodes should be preserved as barriers and which should be removed as potential sources of spread

There may be breast cancers, as there are cancers of the head and neck, which never metastasize systemically They remain localized in the breast and lymph nodes for long periods Such tumors can be controlled by radical surgery. Operation in these cases is the best possible treatment, as it is in cancers of the head and neck and papillary cancers of the thyroid

In skin cancers in which the growth and its zone of metastasis are observable, so-called prophylactic lymph node dissections have not been proved more effective than those performed when the metastatic disease becomes apparent. There is no proof that treatment is less effective if the primary tumor is widely removed, its zone of metastasis observed, and metastases treated later if they appear Perhaps a graded approach to treatment of some cancers, other than those of the skin, would be of value

► [The views expressed by Dr Crile have been subject to some criticism on the basis that they represent a retreat from the more vigorous surgical attack on cancer Much of this criticism, however, stems from misunderstanding or misinterpretation of his views Indeed, a close review of this article as well as others he has published along these lines reveals little in principle which would represent a radical departure from current surgical teaching Certainly no one would disagree with his main plea—to take a more critical and objective attitude toward surgical cancer therapy—Ed]

Cancer Cell Seeding of Operative Wounds as Cause of Failure in Surgical Treatment of Cancer was investigated by Robert R Smith and Albert W Hilberg[3] (Nat'l Inst of Health)

METHOD—Patients with cancers which by accepted standards were considered operable, but which by reported end results would have a high incidence of local recurrence, were treated by usual *en bloc* cancer surgery Just before closure of the skin flaps following removal of the primary tumor and its lymph node drainage area, the wound was thoroughly washed with sterile physiologic saline solution The washings were collected in a glass container and mixed as soon as possible with the fixative of 70 or 95% alcohol and then centrifuged at 2,500 rpm Part of the sediment was covered with 10% Formalin and the button of fixed sediment was embedded in paraffin and sectioned Another part of the sediment was smeared directly on glass slides which were then immersed in a solution of equal parts of 95% alcohol

(3) J Maine M A 48 151 156 May 1957

and ethyl ether After 30 minutes and while wet the slides were stained by the Papanicolaou technic

In the first 113 patients studied, cancer cells were demonstrated in 31 (positive results), and 16 other results were labeled suspicious In the other 66 patients, no tumor cells were found

At present, 18 of these patients are known to have recurrent cancer In 1, it was definitely known that cancer was transected at operation, and in another, it was likely that the recurrence was a second primary Three patients died a few weeks after surgery There are 7 known seeded recurrences in the operative area in patients with positive washings, 2 recurrences in patients with suspicious washings and 7 recurrences in patients whose washings were negative for tumor cells

It is believed that in some cancer cases, local seeding can be shown to be a cause of treatment failure If effective local chemotherapy can be accomplished at primary surgery, an appreciable increase in salvage rate should be obtained

Prophylactic Treatment of Malignant Disease with Nitrogen Mustard and Triethylenethiophosphoramide (ThioTEPA) Evidence is overwhelming that cancer cells may be disseminated by operation Gerald O McDonald, Charles Livingston, Carroll F Boyles and Warren H Cole[4] (Univ of Illinois) now use anticancer agents prophylactically at operation Anticancer drugs so far available are not curative when given to patients with advanced cancer, but they may be effective in killing "loose" cancer cells which have no vascular root" They may also destroy or subdue the growth of microscopic nests of cells

Rats which received an injection of a suspension of Walker 256 carcinosarcoma cells into the portal system had fewer 'takes" if nitrogen mustard and/or thioTEPA were given the day of injection ThioTEPA appeared slightly more effective than nitrogen mustard The greater the number of cells injected, the less effective the anticancer prophylaxis The same tolerance to a small dose of cancer cells may exist in humans, and host resistance to such a dose may be similar to host resistance to minor contamination of wounds with bacteria Animal experiments also indicated that if treatment

(4) Ann Surg 145 624-629 May 1957

pedicle and ureter should always be identified so that they are not sectioned at the beginning of the dissection This is facilitated by inserting a ureteral catheter before operation With care, the tumor can be completely removed in such cases without nephrectomy

Immediate surgical results are variable, with postoperative mortality of 15-20%, primarily due to operations for adherent tumors—myxomas, sarcomas and teratomas Cysts lipomas and fibromas carry practically no mortality Radiation is ineffective for teratomas and lipomas, but sarcomas are sensitive Of 11 patients with retroperitoneal sarcoma given radiotherapy, 1 survived 5 years and 1 lived 10 years

Late results remain somewhat questionable Recurrences or metastases are numerous, not only from sarcomas but also from many tumors considered clinically and even histologically benign Definitely favorable prognosis should never be given except for wolffian cysts, but too much pessimism is unwarranted because, though sarcomas are almost always fatal, benign mesenchymal tumors and dysembryomas have been successfully treated

Hemangiomas in Infancy and Childhood. Report Based on 6,479 Cases is presented by Donald W MacCollum and Lester W Martin[6] (Children's Med Center, Boston) Capillary hemangiomas ("strawberry" or "raspberry" marks) are the commonest types Frequently, they have an underlying cavernous component As a rule, they are present at birth and there is often a history of rapid growth during the first few months of life Unless this growth is halted by treatment, it may reach a certain size and then remain stationary, or it may regress spontaneously Occasionally, it runs a fulminating course with widespread tissue destruction and disfiguration During any period of rapid growth, the question of malignancy must be considered Of 572 biopsies, hemangioendothelioma was diagnosed in 68 All lesions from which these biopsies were taken, had a benign course subsequently

Infarction is generally believed to be the means whereby spontaneous regression is produced If the entire lesion becomes thrombosed at the same time a huge ulceration may occur which is slowly replaced by scar tissue

For actively growing capillary lesions, x ray has proved to be the most satisfactory treatment The usual dose is 200 300

(6) S Clin North America 36 1647 1663 December 1956

r in air given to penetrate to the depth of the lesion The x-rays are filtered through aluminum and sometimes through copper, depending on the effect desired to the superficial skin Usually, one treatment is given, and if after 6-12 months the regression is unsatisfactory, a second treatment may be given Small doses of x-ray at widely spaced intervals produced satisfactory regression of the hemangioma in 98 9% of patients

The authors use carbon dioxide snow for purely capillary lesions smaller than 0 5 cm One application for 15-20 seconds is generally adequate to freeze the lesion sufficiently and cause its obliteration within a month's time

Treatment of a hemangioma with surface ulceration should be designed to promote healing as rapidly as possible After healing, definite treatment is rarely necessary because once regressive changes have begun they generally continue until the entire hemangioma has been obliterated

The purely cavernous hemangiomas tend to be quite stable in their existence They often show a period of rapid growth during early life, especially if they present cutaneous capillary elements In some patients, a slow progressive growth may continue almost indefinitely Its presence is usually an indication for treatment X-rays were most effective in elimination of both the mixed and purely cavernous lesions However, deeper penetration of the x-ray, with more skin protection from copper and aluminum filters than for the capillary lesions was often indicated When the lesion is pedunculated or well demarcated, surgical excision may be the treatment of choice Endothermy coagulation of cavernous hemangiomas is rarely necessary

Spider telangiectases (stellate hemangiomas) may be first noted shortly after birth or may develop several years later or during adolescence They rarely grow out of proportion to the growth of the child, many will eventually fade Some disappear spontaneously after an infectious disease with associated fever and skin rash A sharp pencil of carbon dioxide snow applied for 15 20 seconds generally results in complete obliteration of the lesion within a month's time Another method consists in piercing the central vessel with the desiccating diathermy needle for a few seconds

Salmon patch (erythema nuchae) is a flat, pink, often extensive intradermal capillary lesion occurring on the fore-

head, upper eyelids, around the nostrils and back of the neck It is seen commonly in the newborn and usually fades within a few months No treatment is indicated

Port wine stains are intradermal capillary lesions which impart a typically mauve discoloration to the skin Primary excision and direct closure may be indicated in small lesions Extensive port-wine stains can best be handled by covering with cosmetic makeup

Hemangiomatous varicosities usually involve either the upper or lower extremity, but they may also extend well up onto the trunk More severe lesions may present multiple arteriovenous shunts X-ray therapy is sometimes helpful to control the growth of capillary extensions For patients with fairly isolated lesions, surgical excision and skin grafts seem the most desirable

Treatment of Malignant Melanoma with Special Reference to Possible Effect of Radiotherapy. Lorentz Nitter[7] (Norwegian Radium Hosp, Oslo) reviews data on 192 patients with malignant melanoma followed for more than 5 years In 167 patients, the primary tumor was in the skin Treatment consisted chiefly of surgery combined with radiotherapy, often with postoperative radium molds on the scar region after primary excision Of the 167 patients, 45 survived more than 5 years 1 with a recurrence Although 35 patients in stage I survived 5 years or more, none in stage III survived 5 years

Of the 36 survivors in the entire material in stage I, 35 received some kind of radiotherapy primarily, subsequent to previous and often extremely conservative excision of the primary tumor Lymph node dissection later was performed in 3 and probably saved their lives Of the 12 survivors in stage II 10 received radiotherapy for lymph node metastases as the main treatment

Results in stage I with postoperative radium mold therapy seemed to be no poorer than in other series in which primary treatment has been radical surgery only

The author suggests that surgery in malignant melanoma of the skin should be no more extensive than to allow postoperative radiotherapy immediately after primary intervention Prophylactic lymph node irradiation should always be given in stage I

(7) Acta radiol 46 547 562 September 1956

Notes on Argentaffin (Carcinoid) Tumors: Three Examples in Childhood (at ages 7-10) are presented by Reginald Webster and Alan Williams[8] (Royal Children's Hosp., Melbourne). The incidence of carcinoid tumor of the appendix has been estimated as 0.1-0.5% of all appendical lesions. The tumor usually presents as a hard, single, yellowish or gray nodule, covered by mucosa. As in 2 of the authors' patients, inflammatory episodes bring about comparatively early recognition and surgical removal of many appendical carcinoids. This is probably why carcinoids of the appendix have been regarded either as benign or of a lower degree of malignancy than those originating elsewhere.

Extra-appendical carcinoid tumors are most often located in the terminal portion of the ileum, where they appear as single or multiple submucosal nodules that grow slowly to project in sessile or polypoid fashion into the lumen of the intestine, to penetrate between the muscle fibers of the circular and longitudinal muscular coats of the bowel and eventually to reach the serosa and enteric mesentery.

Tumors of the small intestine often provoke intussusception. In the authors' third patient, intussusception led to early disclosure of the carcinoid tumor of the ileum by surgical intervention. Development of a tumor mass on the serosa or adjacent mesentery and resulting adhesions to contiguous loops of intestine thereby were forestalled, as were the concomitant knuckling and kinking of the bowel and annular stricture likely to result from contraction of the fibrous stroma of the tumor.

All "carcinoid" or argentaffin tumors are thought to be innately malignant, though in their characteristically slow progress many do not reach the stage of metastatic spread.

Some Aspects of Pathology and Clinical Features of Intestinal Carcinoids are discussed by F. Feyrter[9] (Univ. of Göttingen) The benign intestinal carcinoid is characterized clinically by colicky abdominal pain, nausea, loss of appetite, flatulence, normal bowel movements or diarrhea alternating with constipation, hot flushes and increased perspiration. X-ray studies show increased bowel motility. Hypoglycemia may develop spontaneously or be elicited by tolerance tests Increased skin pigmentation may be present,

(8) M J Australia 2 553 558, Oct 13, 1956
(9) Deutsche med Wchnschr 81 1073 1077, July, 6, 1956

which in advanced disease may be of the pellagroid type. Sequelae include cholecystitis, gallstones and liver damage, occasionally developing into cirrhosis. Some patients have a tendency for allergic manifestations, others for psychopathic changes. Chronic alcoholism is frequent among these patients.

Pathologic findings in benign intestinal carcinoid include increased incidence of cholecystitis and cholelithiasis, liver cirrhosis, diabetes mellitus and occasional islet adenoma, adrenal cortical hyperplasia and adenomas and increased susceptibility to overwhelming bacterial infection. The eosinophil cells of the adenohypophysis are often increased in number. Extracts from bowel carcinoids revealed large amounts of 5-hydroxytryptamine, as well as zinc.

The malignant intestinal carcinoid presents generally the symptoms and signs of the benign variety, but in a more severe form. The diarrhea, for example, may last for years with frequent daily bowel movements and uninterrupted by formed stools. Fibrotic changes of the endocardium and valves, mainly in the right heart, seem to occur only in the malignant form, especially with liver metastases. The fibrotic changes seen in the endocardium and occasionally in the pelvic tissues might be due to a fibrotizing factor produced by the carcinoid.

Metastasizing Carcinoma (Argentaffinoma?) of Unknown Origin Showing Peculiar Red Flushing and Increased Amounts of Histamine and 5-Hydroxytryptamine in Blood and Urine was studied by Jan Waldenström, Bengt Pernow and Hans Silwer.[1]

Woman, 62, had had attacks of redness in the face for at least 15 years accompanied by hotness in the skin, some itching and rarely tachycardia but without fever or headache. Examination revealed signs of tumor (metastasis?) in the lungs and as osteoplastic foci. The primary tumor was not found and there were no clinical signs of abdominal tumor. The liver was considerably enlarged, suggesting the possibility of a metastasizing carcinoid even though pulmonary and osseous metastases are exceptional in carcinoidosis.

Clinical investigation showed that the flushes were provoked by eating (especially strong cheese), by alcohol and by heat, but obviously not by psychic factors. The mere chewing of cheese had no effect. Blood pressure showed no change during attacks. The flushes might be short or last over an hour. A long and severe flush (Fig. 7) did not protect against a new one started, e.g., by a meal. The number of

(1) Acta med. scandinav. 156: 73-83, 1956.





Fig 7 —Spontaneous severe flush Face is bright red and patches on trunk, arms nd legs are of same color, as distinguished from changing colors seen in typical car inoidosis

Fig 8 —Erythematous patches on arms After intracutaneous histamine bright red spot on left arm shows same color as spontaneous flush

(Courtesy of Waldenstrom J et al Acta med scandinav 156 73 83 1956)

flushes per 24 hours might be 6-8. Between flushes, the skin showed no dermographism on stroking. Lines that had been stroked previously, however, became bright red and swollen as soon as a flush came on. If circulation was cut off at the start of flush no dermographism developed after it was re-established and the general flush was fading, but the next flushes gave dermographism in this location for about 24 hours. Antihistaminics seemed to have a definite but not marked influence on the flushes. A flush induced by intracutaneous injection of histamine (0.5 mg.) had the same color and localization as a medium spontaneous flush (Fig. 8). There was considerable increase of histamine, 5-hydroxytryptamine and 5-hydroxyindole acetic acid in blood and urine. Urinary excretion of histamine in 24 hours was 4-8 mg. (normal 6-19 μg.); of 5-hydroxytryptamine, 3-5 mg. (normal less than 0.1 mg.); of 5-hydroxyindole acetic acid, 25-170 mg. (normal 2-10 mg.).

Mechanism of the flushes in this case was not thoroughly explained. The rapid response after eating cheese makes it probable that the histamine liberator is released from gastric mucosa rather than from tumor tissue. That there is a connection between the flushes with the external characteristics of histamine flushing, increase of histamine in blood and urine and the presence of tumor has been tacitly supposed.

5-Hydroxytryptamine (Serotonin) and Its Relationship to Carcinoid-Cardiovascular Syndrome and Rendu-Osler-Weber Syndrome. The carcinoid-cardiovascular syndrome is characterized by intestinal carcinoid tumor with liver metastasis, dependent edema, diarrhea, telangiectasia, asthmatic attacks, flushing and cyanosis, pulmonary stenosis, and tricuspid insufficiency Cyanosis is violaceous in color and transient, and telangiectasia has been found principally on the face. Twenty-one valid instances have been reported in the literature. To this series Charles H. Sparks and Thomas L. Tombridge[2] (VA Hosp., St. Louis) add 1 patient.

Serotonin, or 5 OH tryptamine (5-HT), is present in the serum after the blood has clotted. It has been extracted in large amounts also from carcinoid tumors. Many symptoms of the carcinoid-cardiovascular syndrome have been elicited experimentally by administration of serotonin.

The authors state that telangiectasia in Rendu-Osler-Weber syndrome is produced by 5-HT which escapes detoxification by bypassing the lungs via a pulmonary arteriovenous fistula (or fistulas), which may or may not be demonstrable clinically or by x-rays It is assumed that, with a given concen-

(2) J Thoracic Surg 33 401-411 March, 1957.

tration of 5-HT in the arterial circulation, a longer time will be required to produce the left heart changes than to produce telangiectasia The telangiectasia commonly seen with pulmonary arteriovenous fistula is probably due to 5-HT escaping detoxification in the lungs by passing through the fistulas If this is true, the syndrome is a result of pulmonary arteriovenous fistulas and is not due to hereditary factors

Study of 356 Carcinoids of Gastrointestinal Tract. Report of Four New Cases of Carcinoid Syndrome Richard A MacDonald[3] (Boston City Hosp) reviewed 356 gastrointestinal carcinoids; 207 (58%) were of the appendix, and 149 (42%) were extra-appendical Of 146 extra-appendical carcinoids that could be graded, invasiveness was found in 67% Of the 149 extra-appendical carcinoids, 24 (16%) had metastasized to the liver or lungs All extra-appendical carcinoids should be considered malignant and reported in terms of invasiveness The surgical implications of these tumors are different than for other gastrointestinal carcinomas Appendical carcinoids are of unusually low invasiveness, no adequately documented case was found in the English literature and in this series of a metastasis beyond regional lymph nodes

MacDonald found a definite relation between widely metastatic carcinoid tumors and certain clinical phenomena, such as skin changes, diarrhea, a large liver, cardiac murmurs and valvular lesions on the right side of the heart The term "carcinoid syndrome" is suggested to denote these findings Nonspecific gross lesions of the left side of the heart cannot be implicated in the carcinoid syndrome

Of 24 cases in this series with liver or lung metastases, 21 were clinically as well as anatomically reviewed, and 4 (19%) exhibited the carcinoid syndrome Gastric and duodenal ulcers, not previously mentioned in connection with metastatic carcinoid, were found in 8 of the 21 patients (38%) By comparison, the incidence of all gastric and duodenal ulcers in 18,486 consecutive autopsies was 5 5%

Not all patients with extensive carcinoid metastases exhibit the features of the carcinoid syndrome, and not all patients with the syndrome exhibit all these features The most constant appear to be the tumor and its liver metastases, episodes of flushing or a constant flush of the skin, a large liver and diarrhea

(3) Am J Med 21 867 878 December 1596

► [It is extraordinary that this carcinoid syndrome has been overlooked so long The lively interest which its recent recognition has provoked has already resulted in a number of significant observations, as indicated in this group of articles, and offers promise of others that may be even more important —Ed]

Pheochromocytoma, a tumor of the chromaffin tissue that secretes pressor amines, is not common but its correct diagnosis and surgical removal is lifesaving At the Mayo Clinic the correct preoperative diagnosis has been made 51 times in the past 11 years by Walter F Kvale, Grace M Roth, William M Manger and James T Priestley[4] During this period 8 873 pharmacologic tests for the tumor were made on 7,993 patients

Pheochromocytomas usually arise from the adrenal medulla, but may occur along the entire length of the sympathetic nervous system If the tumor secretes pressor amines intermittently, the patient will have attacks of sudden rapid rise of blood pressure with tachycardia, great anxiety, severe headache, pallor, numbness, tingling and coldness of hands and feet, sometimes nausea and vomiting, pain in the epigastrium and excessive sweating They may occur as often as 10 20 times daily or only once every 2 3 months Commonly, the attacks last 10-15 minutes, but they may last a few seconds or several hours If the secretion of pressor amines is rather continuous, the patient may have sustained hypertension Patients with pheochromocytoma are usually thin and many lose weight gradually

The histamine test, 0 05 mg histamine base intravenously, is valuable during the normotensive phase In the presence of pheochromocytoma, it will cause a paroxysmal rise in pressure The cold pressor test should always be the control standard In screening patients with sustained hypertension suspected of having the tumor, Regitine® may be used effectively It probably is unnecessary in obese patients If these tests fail to settle the diagnosis, estimation of the pressor amines in the blood at the highest blood pressure level will prove or disprove it

A needle should be inserted into a vein before anesthesia and kept there during surgery Blood pressure should be recorded at minute intervals Regitine® may be necessary during induction of anesthesia or when the tumor is manipulated Manipulation should be minimal Postoperatively,

(4) Circulation 14 627 630 October 1956

ophed* may be necessary to maintain the blood pressure. e anterior abdominal approach facilitates exploration of h sides and the sympathetic chain.

resent Status of Diagnosis and Treatment of Pheochro- cytoma. This neoplasm of chromaffin cells of the sympa- tic nervous system is now being diagnosed in vivo with reasing frequency. Methods of diagnosis are reviewed by S. von Euler and G. Strom.[5]

The tumor usually develops in adult life, in or near the enal glands. If untreated, the outcome is usually fatal h a clinical course resembling malignant hypertension. e tumor retains the secreting function of the chromaffin l system, augmenting urinary excretion of norepinephrine l sometimes of epinephrine. The exaggerated secretion of echol amines into the circulation produces several nges: arterial hypertension, increasing both systolic and stolic blood pressure; inconsistencies in resting pulse e; increased sweating; cutaneous vasoconstriction; in- ased basal metabolism; increased fasting blood sugar and netimes glucosuria; and central nervous excitation. In ne, the augmented secretion of catechol amines is inter- ttent with "paroxysms" of effector reactions, but in most tients it is continuous. Subjective symptoms are usually adache, sweating, nervousness and loss of weight.

Pharmacologic tests (provocative or blocking, using his- nine or Regitine®) may help establish the correct diagno- , but ultimate diagnosis depends on the estimation of uri- ry excretion or blood concentration of catechol amines his method has several advantages over others: it incurs risk or inconvenience to the patient and can be repeated en Since it is based on quantitative estimation of the path- enic factor, there is little chance of false positive or false gative results, which occur with other methods. In all pa- nts showing clinical signs of a secreting tumor, catechol nine excretion is increased and the proportion of nor-

tisympathomimetic agents (Benzodioxane, Dibenamine®, or preferably, Regitine®) can be used temporarily to combat a spontaneous paroxysmal attack or one provoked by pharmacologic diagnostic stimulation, diagnostic palpation, or anesthesia and manipulation of the tumor during operation When the tumor has been removed, norepinephrine given intravenously for variable periods and sometimes in high dosage is usually necessary to prevent hypotension

Urinary catechol amine levels should be determined after operation to ascertain the success of the surgery A high arterial blood pressure after an apparently successful operation may be due to hypertension before the tumor appeared, vascular changes secondary to the elevated blood pressure caused by the tumor or remaining undetected tumor tissue Urinary analysis of catechol amines may differentiate these possibilities

Surgical Significance of Isolated Axillary Adenopathy is discussed by E Harris Pierce, Howard K Gray and Malcolm B Dockerty[6] (Mayo Clinic and Found) Of 222 patients studied by axillary node biopsy, 72 (31 men and 41 women, aged 21 83) had unilateral involvement only and no cause could be found on routine examination to explain the adenopathy Bacteriologic studies of biopsy materials in which fresh frozen sections indicated the presence of an inflammatory lesion revealed Mycobacterium tuberculosis in two specimens Malignant lymphoma occurred as isolated axillary adenopathy in 10 patients In 50, the nodes showed either inflammatory changes or fat replacement This information was of negative diagnostic aid In 3 of 5 patients with metastatic adenocarcinoma, the primary source was the breast

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THE THYROID AND PARATHYROIDS

Aberrant Thyroid Tissue II Thyroglossal Anomalies; Follow-up Study of 58 Cases (64 pathologic specimens) 1-32 years after operation (average 9 years) is reported by Jørgen B Dalgaard and Per Wetteland[7] (Univ of Bergen) Age range of patients was from infancy to 80 years, 31 were fe-

(6) Ann Surg 145 104 107 January 1957
(7) Acta chir scandinav 111 444 455 1956

males. No case of lingual thyroid was found; localization was suprahyoid in 14, thyrohyoid in 38 and infrathyroid in 12. There were 38 cysts, 20 sinuses, 3 fistulas and 3 solid nodes. The epithelial lining was of a squamous, transitional, respiratory or salivary type, often surrounded by chronic inflammation, or the epithelium was replaced by granulation tissue. Thyroid or salivary gland tissue and even sebaceous glands were encountered in the cyst wall. Lumps consisted of normal thyroid tissue.

The main symptom of a cyst was a tumor in the midline of the neck, sometimes present at birth or for several years. In 10 patients, the tumor first appeared during an acute infection; in a few, the tumor decreased when infection subsided. In 2, tumors increased during mastication. One single large tumor dislocated the larynx and interfered with swallowing. Tumors usually were not painful, but in some patients, acute and painful swellings occurred, often with other inflammations. Fistulas were formed by spontaneous perforation or because of necessary drainage incisions.

One aged patient died without recurrence; all other patients are well. There were recurrences in 18, so total operations numbered 83: 11 incisions (recurrence in all), 59 extirpations or excisions (17 recurrences) and 13 radical operations with resection of hyoid bone (1 recurrence). One tumor, in a woman, aged 44, was classified as a solid low-grade carcinoma in a suprahyoid cyst. Despite recurrence after 13 years which required reoperation, the patient was free of symptoms 28 years after the first operation.

Management of Thyrotoxicosis is reviewed by Victor Riddell[8] (St. George's Hosp , London). The barrier which has arisen between medical and surgical methods of treating thyrotoxicosis is highly artificial and due to unfamiliarity with what, in practice, are often alternative methods of management. Three methods are available: surgical (short-term), pharmacologic (long-term) and radiotherapeutic. The surgeon must see the patient in the original thyrotoxic state, at its worst, before therapy has started. If the patient is first seen after the effect of antithyroid agents has been obtained, the severity of the disease may be underestimated and a wrong decision made as to need or time for operation

(8) Brit J Surg 44 25 55, July, 1956

Patients with thyrotoxicosis may have some special feature which is a clearcut indication for surgery In others, no such indication is present, and the decision between short-term or long term treatment may be resolved only after observation The patient's age, facilities available and the presence or absence of a precipitating factor must be considered The next step should be to determine the desirability of surgery It is irresponsible to try antithyroid methods initially on all patients indiscriminately and to pass to surgery only those labeled "medical failures" Age is the best guide for deciding the definitive therapy in this indeterminate group Surgery is indicated in patients aged 18-40, medical methods in those older This is because of the high relapse rate associated with antithyroid drugs, the hyperplastic response of the thyroid itself to these drugs and the tedium of prolonged treatment and supervision Medical treatment is indicated at the extremes of life, at times of unusual but passing stress, such as puberty, pregnancy and the menopause and in patients with mild, recurrent postoperative or masked thyrotoxicosis

Long-term therapy with antithyroid drugs differs from short-term therapy In the former, the patient is taken to full clinical recovery and maintained at least 1 year In short-term therapy, usually preoperative, the antithyroid agent should be given as briefly as is consistent with bringing the patient to euthyroidism by the day of operation Some, notably certain thyrocardiac, patients who have lost weight excessively and patients with long-standing neglected thyrotoxicosis probably should be taken to full clinical recovery and held there with antithyroid drugs until body weight returns to normal and a constitutional reserve is obtained

Patients selected for surgery at the outset should have special care to determine if antithyroid agents in addition to iodine are needed to bring them to safe operative levels Patients selected for long-term therapy should be re-evaluated not later than 2 months after onset of treatment, and if they do not respond satisfactorily the drugs should be discontinued Overdosage must be avoided toxic granulopenic reaction sought and the danger of operating on a patient with hypothyroidism recognized

Radioiodine has great potential and is theoretically an

ideal treatment. It is absolutely contraindicated in children and in pregnancy. It is most valuable in treating patients resistant or sensitive to antithyroid drugs and in postoperative recurrent thyrotoxicosis as an alternative to such drugs.

Surgery of the thyroid gland has kept pace with other advances in antithyroid treatment and is safer and surer than a decade ago. In skilled hands, combined with careful medical preparation and selection, it is the most generally applicable method of treatment. Subtotal resection is preferred because postoperative recurrent thyrotoxicosis is now more readily controlled than postoperative thyroid insufficiency, which requires permanent substitution therapy.

Nodular Goiter is discussed by James Paterson Ross[9] (St. Bartholomew's Hosp., London). Multiple nodules in the thyroid are the late result of hyperplasia of the gland. In treatment of nontoxic goiter with multiple nodules, dried thyroid substance or iodine should be tried before deciding on surgery. Thyroidectomy is required for nodular nontoxic goiter to relieve pressure on the trachea, and to decompress the groups of smaller follicles which maintain thyroid function. Removal of a bulky goiter may correct hypothyroidism, if there is adequate blood supply to the gland tissue left.

Identification of a thyroid nodule as an adenoma, clinically or at operation, depends more on the normality of the rest of the gland than on the abnormal character of the nodule. If there is only one other nodule, however small, the lump is probably a particularly prominent nodule in a multinodular goiter.

Clinical recognition of an adenoma depends on the fact that the swelling in the thyroid is single and circumscribed and that the rest of the gland is not enlarged. When it is in a lateral lobe, a valuable sign is displacement of the trachea. When diagnosis of adenoma is established at surgery, the lesion should be removed with a little of the compress gland tissue surrounding it. A 10-year follow-up of 150 patients from whose thyroids adenomas were removed indicated that other nodules do not develop.

True toxic adenomas show secretory hyperactivity. An adenoma may be hyperactive without producing clinical hyperthyroidism, because if the tumor is of only moderate size,

(9) J Roy Coll Surgeons Edinburgh 2 81 92, December, 1956

and function of the rest of the gland is inhibited by thyroxin formed by the tumor, the result may be "normal" thyroid function till the tumor grows enough to produce toxic manifestations

Cellular proliferation is limited in the normal thyroid by production of thyroxin, but in nodular, nontoxic goiter, failure of this mechanism may eventually cause such abnormal cell growth that the result is a neoplasm If this theory of the relation between nodular goiter and carcinoma is accepted, it must be in the hyperplastic follicles between the nodules and not in the inactive nodules that carcinoma arises The gland becomes carcinomatous not because it is nodular, but because of a primitive defect in function It is thus possible to explain the high incidence of carcinoma of the thyroid in endemic areas and its comparative rarity elsewhere A solitary nodule in the thyroid should be removed as soon as recognized

Long-Term Follow-up of Nontoxic Nodular Goiter Effect of Clinical Selection on Observed Incidence of Malignancy Joseph E Sokal[1] (Yale Univ) studied 296 patients in whom the diagnosis of nontoxic nodular goiter was made during 1921-45 Only 1 of 140 patients selected for nonsurgical treatment proved to have thyroid cancer An estimated 8,000 patients received no surgical therapy Few thyroid cancers occurred among this group In contrast, 16% of patients selected for thyroidectomy had cancer

The study represents 3,000 patient-years of observation of persons with nontoxic nodular goiter No new thyroid cancers became evident during this time This confirms previous estimates of the low incidence of malignancy in this condition

Most nontoxic nodular goiters need not be extirpated There are dangerous goiters, however, which should be removed Enlarging, firm, discrete tumors of the thyroid should be removed Nodules producing distinct pressure symptoms are best treated surgically Soft, smooth, round nodules which do not grow may be left alone Among older patients, irregular partially calcified masses which have not changed in many years may be found, these too may be ignored Nodules appearing during pregnancy often regress spontaneously Treatment with iodine or desiccated thyroid

(1) A M A Arch Int Med 99 60 69 January, 1957

may produce regression of others Clinical estimation of the number of nodules in a goiter is of little value "Uninodular" goiters often turn out to be multinodular, whereas the presence of 2 benign nodules confers no magical protection against the development of a 3d malignant one

Since the *prognosis* in thyroid cancer depends principally on the biologic characteristics of the tumor and is little affected by minor delays in surgical treatment, a physician may properly take several months to decide whether or not an apparently benign goiter should be removed

Differential Diagnosis, Pathology and Treatment of Substernal Goiter were discussed by Gustaf E Lindskog and Ira S Goldenberg[2] (Yale Univ) with a report of 31 patients, aged 28-78, operated on in 10 years In 14, there were no symptoms and diagnosis was made radiologically

A goiter was defined as substernal or mediastinal if its lower border was found radiologically to reach the level of the transverse processes of the 4th thoracic vertebra or lower Entrapment of the enlarging goiter is usually a gradual process, and there is danger of tracheal obstruction and other symptoms of mediastinal pressure as well as the slight possibility of malignancy

In this series, the final pathologic diagnoses were fetal adenoma, 14 , colloid adenomatous goiter, 11 ; microfollicular adenoma with focal hyperplasia, 6, and carcinoma, 1 There was one postoperative death in a woman 74, who displayed a hemorrhagic tendency of undetermined origin after operation

Incision of a standard collar type proved adequate in 28 patients Further incision through the upper part of the sternum was necessary in 2 and supplementary posterolateral thoracotomy on the left in 1 An incision partially splitting the upper portion of the sternum is suggested as an adjunct to the cervical approach when (1) carcinoma is diagnosed or strongly suspected, (2) the mediastinal component is not in anatomic continuity with the cervical thyroid lobes, (3) previous thyroid surgery has produced dense and vascular adhesions around the substernal component, (4) kyphosis of the cervical spine curtails the anterior exposure, or (5) unexpected technical difficulties arise

(2) J A M A 163 527 529 Feb 6 1957

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(2) J.A.M.A. 163:527-529, Feb. 6, 1957.

Lymphadenoid Goiter (Hashimoto's Disease): Diagnostic and Biochemical Aspects. According to Deborah Doniach and R Vaughan Hudson[3] (London), preoperative diagnosis of lymphadenoid goiter can be made by the combination of I^{131} tracer tests, the older tests of thyroid function and the finding of increased gamma globulins in the serum, which, in absence of liver disease, give rise to abnormal flocculation tests In 28 cases of lymphadenoid goiter, I^{131} tests showed normal or high uptakes even in the presence of myxedema and a uniform distribution of isotope corresponding with the outline of the goiter Short biologic half-life and high plasma activity suggest a small thyroid iodine pool Other tests indicated deficient protein binding and thyroxin storage

Liver function tests and differential serum protein estimation were performed on 11 patients with lymphadenoid goiter (Hashimoto's disease), 25 patients with this disease previously subjected to thyroidectomy, and two control series, one consisting of 25 patients with other types of goiter and the other of 8 myxedematous patients without goiter There was a significant rise in serum gamma globulin levels, as determined by paper electrophoresis, and abnormal flocculation values in the group of untreated lymphadenoid goiters as compared with the control series In the postoperative group there was a return to normal of the gamma globulins The findings suggest that paper electrophoresis in combination with flocculation tests provides diagnostic help in distinguishing lymphadenoid goiter from simple nontoxic goiter and from carcinoma of the thyroid

The authors suggest that the raised serum gamma globulins represent an immune response to an antigen released by the goiter

Subacute Thyroiditis, Struma Lymphomatosa (Hashimoto's Disease) and Chronic Fibrous Invasive Goiter (Riedel's Disease) Clinical Study Based on 20-Year Series of 83 Cases is presented by Gunnel Frid and Hjalmar Wijnbladh[4] (Stockholm) The study included 31 patients with subacute thyroiditis 29 with struma lymphomatosa, 1 with Riedel's disease and 22 with unclassifiable thyroiditis

Subacute thyroiditis is characterized by epithelial destruc

(3) Brit M J 1 672 678 Mar 23 1957
(4) Acta chir scand nav 112 170 185 1957

tion and giant cell formation, Hashimoto's disease by diffuse infiltration of lymphoid cells and Riedel's disease by connective tissue growth of the infiltrative type The clinical course and the histologic findings vary according to whether the disorder involves a normal or goitrous gland Therefore, the authors believe that the large group with "unclassifiable thyroiditis" includes cases of subacute thyroiditis and Hashimoto's disease in patients with goiter, as well as "thyroiditis" taken to express common secondary degenerative changes in an old goiter or the sequela of medical treatment

Subacute thyroiditis is, except for adenomatous hemorrhage, the commonest cause of painful enlargement of the thyroid gland It generally affects women aged 30-50 Onset may simulate the common cold, being marked by general malaise, fatigue, sore throat and fever Pain is situated in the neck and often radiates behind the ears The condition is often misdiagnosed as pharyngitis Temperature may be subfebrile or, more rarely, febrile and fluctuating In early stages the lesion is confined to a certain portion of the gland Later the pain characteristically migrates to other parts of the gland The sedimentation rate is elevated and the BMR elevated or normal Iodine tracer tests show diminished uptake and increased urinary excretion, as in hypothyroidism The serum protein-bound iodine (PBI) is increased, as in hyperthyroidism The disorder may clear spontaneously though it may last for several weeks to months, remissions alternating with recurrences of varying severity The immediate effect of cortisone and ACTH was always striking

Hashimoto's disease generally affects only women, usually aged 35-55 Onset is insidious The patient usually seeks medical advice for the goiter, which may or may not produce constitutional symptoms The chief symptom is fatigue with symptoms of hypothyroidism The BMR is low or normal The iodine tracer test shows normal values or suggests hypothyroidism, but after the 24 hour interval, uptake may be high and the amount excreted small, as in hypothyroidism The PBI is normal or low The disease usually responds promptly to thyroid therapy

A special characteristic of Riedel's disease is growth simulating malignant tumor The only satisfactory therapy is surgery In many patients with unclassifiable strumitis dif-

ferentiation from carcinoma cannot be made without operation

Invasive Fibrous Thyroiditis (Riedel's Struma) is an extremely rare clinicopathologic entity Lewis B Woolner, William M McConahey and Oliver H Beahrs[5] studied 20 patients seen at the Mayo Clinic in 36 years, during which about 42 000 thyroidectomies were done Histologically, Riedel's struma is a destructive inflammatory lesion, lacking a foreign-body, giant cell reaction, which extends beyond the thyroid capsule into adjacent structures This invasiveness makes the process basically ineradicable

The presenting complaint of the patients was a hard lump in the neck, occasionally associated with a sense of pressure or dysphagia The disease may be unilateral or bilateral and invariably extends into adjacent structures Patients must be explored surgically, because of the hard fixed mass involving one or both lobes of the thyroid Diagnosis must be established by histologic examination of the involved tissue Biopsy itself may be sufficiently extensive for the surgical treatment, which consists essentially of wedge resection of the isthmus and inner aspects of both lobes in the diffuse form, or partial removal of a localized mass if the disease is unilateral

Follow up data suggest that the process is self limiting and that freeing the trachea provides a satisfactory guarantee against subsequent obstruction There is little evidence that the postoperative course is in any way dependent on removal of an adenoma during operation In 5 patients in whom an adenoma involutionary nodule or cystic cavity was found the subsequent course of the disease did not differ from that of other patients

Carcinoma of Thyroid Review of 100 Cases is presented by R Kilpatrick, G W Blomfield F E Neal and G M Wilson[6] (Sheffield, England) The 20 men and 80 women were seen at a radiotherapy center in a region where goiter is common Mean age was 54 9 years with no age difference between the sexes Eighteen had a history of previous goiter for more than 5 years 7 had coexistent hyperthyroidism and 1 had coexistent hypothyroidism Most thyroid carcinomas do not arise in adenomatous goiters

(5) J Clin Endocrinol 17 201 220 February 1957
(6) Quart J Med 26 209 233 April 1957

The commonest initial symptom was thyroid swelling In only 5% was the first symptom remote from the thyroid and due to pain or pathologic fracture from a bony metastasis In 6%, enlargement of 1 or more cervical lymph nodes was the first complaint These cases correspond to those formerly classified as lateral aberrant tumors, but a primary thyroid carcinoma was always present Pressure symptoms were rare

In many cases, which later prove to be malignant, a clinical diagnosis of thyroid cancer cannot be made Suspicious features are a hard and irregular swelling, fixation to surrounding structures, rapid increase in swelling, especially if producing pressure symptoms, and vocal cord paralysis More certain criteria are cervical gland enlargement and evidence of remote metastases However, a thyroid swelling that is not hard, irregular or fixed does not exclude thyroid carcinoma

Papillary carcinoma comprised the largest group (45%) among the 78 patients from whom tissue was obtained at biopsy, operation or autopsy It was commonest among the younger patients The female preponderance in the series as a whole was retained in each histologic type Most patients were treated by operation followed by deep x-ray therapy or by deep x-ray therapy alone The 5-year survival rate in the former was 52%, in the latter 18 2%

Concentration of radioiodine by tumor tissue occurred in only 7 patients In 1, carcinoma was diagnosed 6 months after I^{131} treatment for thyrotoxicosis In 3 of 8 with carcinoma before age 35 there was a history of ionizing radiation to the neck in childhood

Cancers of Thyroid: **233 Surgical Cases** in 1930 50 (2 9% of 8 000 thyroidectomies) were analyzed by H Welti, R Hugenin and J Roujeau [7] There were 34 papillary carcinomas, 35 Langhans tumors, 23 vesicular epitheliomas, 132 undifferentiated epitheliomas, 4 sarcomas and 5 metastases from remote cancers The tumor was completely removed in 196, and 184 patients were followed over 6 years or until death In 127 cases in which radical operations were performed, a radium collar was applied postoperatively I^{131} was used in treatment of 3 late metastases, 7, 11 and 14 years after operation Irradiation in inoperable cases usually was unsuccessful, but

(7) Bull Assoc franc étude cancer 43 171 179 Apr J ne 1956

in 2, results were spectacular with disappearance of the tumor and lasting cure

Results in this series as in 231 more patients operated on since 1950 show that thyroid cancer is curable, but success is significant (87%) only when the tumor is encapsulated (stage I) In stage II, results were successful in 51%, and in stage III 19% In the initial phase, the clinical picture often is that of benign adenoma Although in certain cases meticulous examination may lead to suspicion of malignancy, more often accurate diagnosis can be made only at operation

Preventive ablation of thyroid adenomas is therefore recommended as the only way to prevent deaths from generalized cancer With early resection development of clinical cancer might have been avoided in 138 cases (59%) in which goiter was present more than 5 years before malignant degeneration occurred Since thyroid cancer is more frequent in endemic goiter regions, better prophylaxis with iodides would reduce its incidence

Small Cell Malignant Lesions of Thyroid Gland In a review of all primary malignant neoplasms seen at the Mayo Clinic between 1929 and 1954, Alexander J Walt Lewis B Woolner and B Marden Black[8] found 30 small cell malignant lesions, of which 18 were malignant lymphomas and 12 small cell carcinomas The average age of the patients with malignant lymphoma was 56 years and of those with small cell carcinoma 53 5 years, women predominated

Unequivocal struma lymphomatosa was present in 2 of 14 cases of malignant lymphoma in which sufficient tissue for adequate sampling was available Prognosis for malignant lymphoma was much better than for small cell carcinomas With the former, 6 of 18 patients were alive and asymptomatic 4 years or more after they were first treated In the carcinoma group, no patient survived longer than 19 months

Apparent cure of lymphoma of the thyroid may occur after unilateral or bilateral thyroidectomy followed by radiotherapy It appears that surgical excision should always be followed by irradiation Surgical treatment of malignant lymphoma of the thyroid should be vigorous and should not be abandoned despite local attachment to muscle or peritracheal and periesophageal tissue

(8) J Clin Endocrinol 17 45 60 January 1957

Thyroid Tissue: I. Lateral Cervical Thyroid Follow-up Study of 39 Cases (24 in females), 1-rage 7) after diagnostic operation, is reported by ilgaard and Per Wetteland[9] (Univ. of Bergen). ation for lateral cervical tumors, which had been w weeks to several years, ranged from 22 to 89 lly, 33 of these lateral thyroid growths were pap-re follicular and 2 showed undifferentiated small ma

es, subsequent thyroidectomy was performed, and omolateral thyroid lobe contained a primary carci-toperative roentgen treatment was given in 10 I^{131} in 5 Follow-up showed 5 deaths in this group causes unrelated to thyroid carcinoma. Two who i malignant thyroid disease lived 18 and 26 years nostic biopsy Another patient is expected to die of arcinoma

cases (10 of papillary thyroid tissue and 2 of undif-ed small cell thyroid carcinoma) clinical diagnosis id malignancy was made, but operation was impos-refused by the patient Ten of these received roent-rapy, 2 with additional I^{131}, 2 refused all therapy. At up, 4 were alive after 3-8 years Eight died from 6 s to 11 years (average 3 years) after diagnostic opera-

2 of the 39 patients, thyroid carcinoma was not proved, thyroidectomy was refused Five received irradiation, he only treatment was extirpation of the lateral tumor patients were all well 1-24 (average 9) years after diag-of lateral aberrant thyroid, although 5 displayed recur-of enlarged lateral cervical nodes at follow-up Of the imors in this group, 10 were predominantly papillary oid, 2 showed the structure of a follicular adenocarcino-with polymorphia and infiltrative growth One of these removed from a man, aged 43, who received postopera-x-ray treatment he was symptom free 11 years later e other was taken from a woman, aged 48, who was free symptoms 6 years later without further treatment

The authors believe these findings offer strong support for e metastatic origin of lateral thyroid tumors A protracted

(9) Acta chir scandinav 111 431 443 1956

course is no real contradiction, but a peculiarity of papillary thyroid carcinoma, the malignancy of which is often low These tumors grow slowly, metastasize late and mainly to the lateral cervical lymph nodes, where "lateral aberrant thyroid tumors" are found Since lateral metastases may remain stationary for several years, the good results observed in several cases do not exclude a metastatic origin Hemithyroidectomy with removal of all lateral tumors is strongly advocated, whereas radical block dissections with removal of the sternocleidomastoid muscle seems unwarranted Post operative irradiation or I^{131} treatment is advised Prognosis is good, even in recurrent cases

►[These carefully performed studies strongly support the now generally accepted theory that so called lateral aberrant thyroid tumors represent metastases from primary carcinoma of the thyroid gland —Ed]

Cancer of Thyroid Gland in Children Donald E Ross[1] (Los Angeles) performed thyroid operations in 1,000 patients, of whom 14 were under age 18 Carcinomas were seen in 7 of the young patients Preoperative study should include basal metabolism and protein bound iodine tests, chest and bone x rays and radioactive iodine uptake estimation with thyrograms If a filling defect is seen in the thyrogram, cancer may be suspected, but other conditions such as cystic areas thyroiditis or adenoma should be considered Any area of firmness or nodularity in the thyroid may suggest malignancy If a firm nodule can be palpated some distance from the thyroid in any neck area, metastasis must be suspected

Radioactive iodine should be given the day before surgery and after surgery the thyroid tissue is mounted on slides and exposed to a photographic film to obtain a radioactive autogram From this, the amount of uptake of radioactive iodine into the tumor tissue is estimated It is important to know if the tumor absorbs iodine when there is metastasis The papillary type absorbs iodine poorly Alveolar and mixed types absorb it more readily Often when there is metastasis, iodine is not absorbed If there has been a total thyroidectomy and all remaining thyroid tissue in the neck has been destroyed by radioactive iodine, the best conditions are established for increased activity and absorption of more iodine in any metastasis

Adequate surgery is important for all thyroid cancer patients The minimum operation should be complete thyroid-

(1) Surg Gynec & Obst 104 433-440 April 1947

ectomy, together with block dissection on the side of the neck on which the cancer occurred. If the neck glands are positive for metastasis, radical resection is done on the opposite side. Angioinvasion should not deter the surgeon from radical surgery. The lymph nodes and areolar tissue between the two carotid arteries down to the arch of the aorta are removed, but the sternum is not split. The dissection is carried down along the innominate and subclavian arteries so all the glands from the upper mediastinum are removed. The esophageal chain of nodes which is often seen posterior to the recurrent laryngeal nerve is carefully dissected. The strap muscles are removed.

Fallacy of Conventional Radical Neck Dissection for Papillary Carcinoma of Thyroid is discussed by George Crile, Jr.[2] (Cleveland Clinic). The most important primary zones of metastases from papillary cancers are the centrally located lymph nodes of the superior mediastinum and the paratracheal nodes behind the thyroid and along the trachea. The jugular chain of lymph nodes is only a secondary zone of metastasis. Lateral cervical metastases from thyroid cancers lie deep to the carotid as well as superficial to it and cannot be resected en bloc without sacrifice of the carotid vessels. Patients with papillary cancer of the thyroid do not die from uncontrolled lateral cervical metastases, but from invasion of the trachea, esophagus and mediastinum by the primary tumor and its centrally located metastases.

Published statistics indicate that the results of extensive and carefully planned conservative operations are better than those following conventional radical neck dissections. This is probably because standard neck dissections neglect the vital central zone of mediastinal and paratracheal metastases. Further, the conservative approach does not lead to deformities and dysfunctions as does and classic block dissection. Many papillary carcinomas of the thyroid are, like endometriosis, amenable to hormone control. Suppression of thyroid-stimulating hormone by daily administration of 3 or 4 gr. of desiccated thyroid often results in regression of the tumor.

► [It is difficult to refute the arguments which Dr. Crile makes against the radical block dissection type of operation for carcinoma of the thyroid. —Ed.]

(2) Ann. Surg. 145:317-320, March, 1957.

Injury to Recurrent Laryngeal Nerves during Thyroidectomy: Comparison between Results of Identification and Nonidentification in 1,022 Nerves Exposed to Risk. Preoperative and postoperative laryngoscopy are necessary for a true record of the rate of injury to the recurrent laryngeal nerve during thyroidectomy. According to V. H. Riddell[3] (St. George's Hosp., London), this rate is most accurately expressed by relating the number of nerves injured to the number exposed to risk. Paralysis of a vocal cord resulting from such injury is not inevitably permanent; cases of complete as well as partial paralysis may in time fully recover.

In this series 1,022 nerves were at risk. The nerve injury rate following thyroidectomy showed a slight bias in favor of identification, but this was not statistically significant. There was no evidence that identification produced a higher injury rate than nonidentification. The surgeon operating on the thyroid gland should arm himself and protect his patient by visually identifying the recurrent laryngeal nerves until he is familiar with their normal course and disposition. Thereafter, deliberate identification may be discontinued except in special cases.

Operative Parathyroid Arteriography for Location of Parathyroid Tumor. R. E. Steiner, Russell Fraser and Ian Aird[4] (Postgrad. Med. School, London) believe that operative discovery of a parathyroid tumor which lies at a distance from the thyroid, especially in the superior mediastinum, may be difficult. Arteriography was useful in locating the parathyroid tumor in 1 case.

Woma[illegible] underwent neck exploration to find the [illegible]tion, location of the parathyroid tum[illegible] of the thyroid gland failed to reveal any nearby parathyroid tumor. Search in the areolar tissue between the thyroid gland and the carotid sheath revealed no tumor, nor [illegible] and the gro[illegible] wer[illegible] inj[illegible] taken. X-ray showed the right lateral lobe of the thyroid clearly outlined by the opaque material and below and rather lateral to it, the outline of the parathyroid tumor (Fig. 9). The tumor was found in the connective tissue of the neck below and lateral to the lateral thyroid lobe about 2 cm. from the lower border of the lobe.

(3) Lancet 2 638-641, Sept. 29, 1956
(4) Brit M J 2 400-401, Aug 18 1956



Fig 9—Parathyroid aortography Needle outlines trunk of inferior thyroid artery *T* right lobe of thyroid gland *P*, parathyroid tumor outline (Courtesy of Steiner R E, *et al* Brit M J 2 400 401 Aug 18 1956)

Operative Exploration of Parathyroid Glands. When a diagnosis of hyperparathyroidism has been established the parathyroid glands are explored Locating a parathyroid tumor can be difficult because the tumor often is small and may lie at a distance from its expected site Moreover, parathyroid tumors are sometimes multiple The operation requires formal exposure of the whole area in which a tumor can lie This area is bounded above by the hyoid bone, below by the arch of the aorta, laterally by the carotid sheaths, in front by the fascia on the deep surface of the infrahyoid muscles and behind by the prevertebral fascia The tumor may lie in relation to the thyroid gland, within the thyroid gland, in the superior mediastinum or quite far laterally in the neck

I. Aird[5] (Univ of London) suggests the following procedure for exploration of a parathyroid tumor

Technic—Since finding the tumor often depends on detection, during operation, of minor asymmetries in the operation field the patient first is placed with strict symmetry on the operating table The

(5) Lyon chir 52 242 245 1956

shoulders must lie squarely, supported on a median pillow, and the chin must point vertically forward A low collar incision is made in the skin fold of the neck, extending from one sternocleidomastoid to the other Skin flaps are raised up to the hyoid bone and down to the sternal notch The sternohyoid and sternothyroid muscles are separated in the midline, and the fascia deep to the second of these layers is opened A finger is swept around on each side between the muscle layers and the surfaces of the lateral lobes of the thyroid gland The infrahyoid muscles are divided high in the neck near their insertions and turned back The thyroid bone is thus exposed, the operator stands back and inspects the operation area, noting any asymmetry The lateral thyroid lobe on each side is mobilized by division of the superior thyroid vessels, middle thyroid vein and inferior thyroid vein, which divide as they pass down over the trachea from the lateral lobes and from the isthmus, sometimes a small tumor occurs among these inferior veins The upper border of the isthmus is defined by division of the fascia that passes upward from the paramedial lobe to the hyoid bone and the lower border of the isthmus is defined, too, so the isthmus can be gently separated above and below from the trachea in front of which it lies, sometimes a parathyroid tumor may lie between trachea and isthmus The medial borders of the lateral lobes are also defined so the upper pole of the gland on each side may be withdrawn from contact with the larynx Stay sutures are inserted into the lateral border of each lateral lobe, to retract the lateral lobes forward, and if the carotid is rejected laterally at the same time, the area in which the tumor lies is well seen

The inferior thyroid artery is exposed, first on one side and then on the other, by tearing through the covering layer of fascia, and as the lateral lobe is retracted by its stay suture, the branches of the inferior thyroid artery are seen Also seen are the lateral border of the esophagus and the groove between trachea and esophagus, with the recurrent nerve The tumor often lies in relation to this nerve, within the groove or even behind the esophagus Usually, by this staged technic a tumor in the connective tissue of the neck will now have been detected But sometimes a tumor lies in the substance of the thyroid gland or alternatively, low in the superior mediastinum A parathyroid tumor within the substance of the thyroid gland usually occasions some asymmetry of that gland, and asymmetry of this kind must be sought Even if thyroid asymmetry is found it may not be significant because a nodule in the lateral lobe of the thyroid is as likely to be a coincidental thyroid adenoma as a parathyroid tumor

Another kind of asymmetry which should be sought and noted is asymmetry in the thyroid arteries Most parathyroid tumors derive their blood supply from one of the inferior thyroid arteries, though occasionally they may be fed from the superior vessel The feeding vessel, inferior or superior thyroid, is always visibly larger in caliber than its fellow on the opposite side The asymmetrically larger vessel is then closely inspected, sometimes from it a vessel

of quite substantial size is seen passing toward the tumor, descending into the mediastinum if the tumor lies there If no tumor has yet been found, inferior thyroid arteriography to outline the tumor is undertaken Into the larger vessel, 10 mm of 30% diodone is injected The artery meanwhile is supported tense on a thread to occlude it just proximal to the needle puncture Toward the end of the injection, an x-ray is taken of neck and upper chest. The lateral thyroid lobe on the injected side is outlined, if the parathyroid tumor lies behind the lateral lobe, it may not show as a separate shadow There should be no difficulty, however, in detecting the tumor with the eye and hand If, however, the tumor lies in the upper mediastinum or in the neck separate from the thyroid gland, it is clearly outlined, when the radiologic site is known, there is no difficulty in exposing the tumor If a shadow is not seen after arteriography of the artery on one side, arteriography is done on the opposite side When outlined, the tumor is easily found and enucleated If it lies in the mediastinum, it can generally be delivered up into the neck by the finger Only exceptionally is it necessary to divide the sternum and explore the superior mediastinum under vision

Before mediastinotomy is undertaken, if a tumor is still undetected, the branches of the inferior thyroid arteries are divided carefully, with respect to the recurrent laryngeal nerve, and the groove between the trachea and the esophagus, a common tumor site, is explored The retroesophageal space is explored also, the finger being passed upward behind the esophagus to the pharynx and downward behind the esophagus to the aorta, first on one side and then on the other If a tumor still has not been found, first one lateral lobe of the thyroid gland is resected and then the other A small stump of thyroid tissue left on each side is adequate for the patient's thyroxin needs When removed, the lateral lobes are serially sectioned in case the tumor should lie within thyroid tissue If a nodule is found in the thyroid gland, microscopic examination is made at once by frozen section to determine whether the nodule is a parathyroid tumor or a concomitant and coincidental adenoma

If after this technic no tumor is found, the wound is closed and the patient returned to bed for further investigation after collection of biopsy material from a suitable bone If the skeleton has not been affected, a small piece of bone may be removed from the sternum or from the 1st or 2d rib If the skeleton is affected, material for biopsy should be obtained by high frequency drill from an affected bone

Successful Embryonic Parathyroid Tissue Transplant for Treatment of Intractable Postoperative Parathyroid Tetany is reported by Henry L Rigdon and Walter R Mead[6] (McLeod Infirm Florence, S C)

Woman, 29, had explosive onset of tetany about 24 hours after bilateral subtotal thyroidectomy for thyrotoxicosis Response to in-

(6) Am Surgeon 22 1222 1224 December 1956

travenous calcium gluconate was dramatic, but administration had to be repeated every 8 hours until she could be stabilized by oral calcium medication On discharge, 17 days after operation, tetany was fairly well controlled

During the next 3 years, the patient was readmitted 11 times and spent 363 days in the hospital because of frequent attacks of tetany Intolerance to oral medication, which caused nausea, vomiting and diarrhea, required intravenous glucose containing calcium gluconate and supplementary vitamins several times daily Liberal use of parathyroid hormone provided little benefit The patient was deteriorating rapidly, mentally and physically.

Finally, fetal parathyroid tissue, obtained at a therapeutic abortion, was implanted under local anesthesia into the right rectus muscle about 2 in below the umbilicus About 5 months later, the patient's clinical course began to improve slowly, but constantly She ceased to have attacks of tetany, and finally all oral medication was stopped, she was discharged about a month later Except for a few minor episodes coinciding with acute infections she has been almost asymptomatic for 2 years and is at present controlled on 15 gr calcium 3 times a day, taken orally She regained normal weight appears healthy mentally and physically and is able to work regularly

The authors believe they were extremely fortunate in getting a take of the transplant by the method used Sterling's vascular anastomosis method, by which he obtained 3 takes, is believed to be the one of choice, despite its technical difficulties

Preliminary Experiences with Transplants of Cultured Parathyroid Tissue in Hypoparathyroidism Roberto F Escamilla, Henry Kempe, Jackson Crane, Leon Goldman and Gilbert S Gordan[7] (Univ of California) on 14 occasions implanted living parathyroid tissue in 11 patients with surgical hypoparathyroidism The implants were prepared by an adaptation of Gillard's method Fragments of fetal parathyroids and, subsequently, of parathyroid adenomas, 1 mm or less in diameter, were grown in tissue culture and gradually adapted to recipient serum before the implant The number of fragments implanted at each operation varied from 13 to 80 The transplants of parathyroid adenoma tissue produced results comparable to those obtained with use of fetal tissue

In 1 patient who had previously been extremely resistant to antitetany therapy, a transplant of fetal tissue remained functional for 9 10 months A second transplant of adenomatous tissue in the same patient has given partial relief from subjective symptoms for 13 months Relief has persisted 19

(7) Ann Int Med 46 649 661 April 1957

months in another patient after transplant of adenomatous tissue. In 6 others, implants gave only transient relief for 1-6 weeks. Implants in the others produced no improvement.

The evidence so far suggests that the success of viable grafts depends on degree of immunologic response of the host tissue to the transplant. It seems probable that the antigen-antibody reaction in the recipient, which causes the frequent rejection of transplanted tissue, will need to be modified before successful implants can be predicted.

Status of Patients Following Homologous Transplantation of Thyroid and Parathyroid Glands. During 4 years, Julian A. Sterling and Ralph Goldsmith[8] evaluated patients with thyroid and parathyroid deficiencies. Three were given donor gland tissue on four occasions. One patient has had no symptoms for 44 months and another for 16 months. The third was relieved of symptoms for 10 days and later for 6 weeks, but now requires much medication. Donor tissue was taken from infants up to age 6 months. Transplantation was accomplished by vascular anastomoses between the vascular pedicles of the donor gland and vessels of the host. In 1 patient, direct implantation was done into muscle. Functioning thyroid tissue was identified with radioactive iodine.

► [The 3 preceding reports indicate that transplantation of fetal thyroid and parathyroid tissue may at times be attended by success. Successful transplantation by the technic of Drs. Rigdon and Escamilla depends not only on acceptance of the tissue by the recipient, but also on the rapidity with which a blood supply is established by ingrowth of capillaries. For this reason it would appear that the technic reported by Drs. Sterling and Goldsmith is the more desirable one, as the blood supply to the transplant is established at the time of operation. With the latter technic, another transplant has recently been performed by Dr. George Jordan on our service, which appears to be successful on the basis of clinical and metabolic studies.—Ed.]

THE BREAST

Cystic Disease of Breast. Daniel J. Pessagno[9] (Univ. of Maryland) believes it can be said with reasonable assurance that breast cancer for the most part occurs in a breast which is the seat of cystic disease and arises as such in the proliferative changes associated with cystic disease. A statistical study was made of 297 cases of carcinoma and 248 of cystic

(8) J. Albert Einstein M. Center 4:133-135, September, 1956.
(9) Am. Surgeon 23:65-72, January, 1957.

disease of the breast. Included as cystic disease were cysts—solitary or multiple—hyaline stroma, cystic dilatation of ducts and acini and intraductal and intracystic papillomas Of the 297 cases of carcinoma, 194 were designated as arising from duct epithelium.

Simple mastectomy was done in 115 of the 248 cases of cystic disease, no operation in 25 and 195 conservative excisions in the other 108 In 13 (12%) of the last, carcinoma later developed, 8 occurring in breasts, the seat of solitary or multiple cysts, and 5 in lesions stated to be intraductal papillomas Bilateral lesions were found in 26 of the 248 cases Of the 297 cases of carcinoma, 90% were associated with cystic disease. In 10 (3%), conservative excisions for cystic disease had been done an average of 6 years before radical mastectomy; the shortest time was 2 months, the longest 20 years Twelve patients had refused surgery when first seen or had been told it was unnecessary.

In solitary cysts, demonstrated by clinical examination, the proper procedure depends on several factors, including the age and wishes of the patient. If local excision is to be done, strict postoperative observation is indicated In patients over age 40, simple mastectomy is the procedure of choice If the disease is localized and the patient is under 40 and desirous of keeping the breast, local excision is done. If another cyst follows, simple mastectomy should be advised or radical mastectomy if cancer is demonstrated Women over age 40 with bloody discharge from the nipple, with or without palpable tumor, should have simple mastectomy since lesions are usually multiple and prone to malignant degeneration If cancer is found, a radical procedure may be done If multiple papillomas are demonstrated, simple mastectomy is the procedure of choice at any age Delay in proper therapy results in loss of life Aspiration is not an efficient or safe treatment for cystic disease of the breast, nor is aspiration and centrifuging of the aspirated fluid an adequate method of diagnosis Such management should be discouraged

► [While there is some evidence to indicate that the incidence of cancer of the breast is somewhat higher in patients with a background of cystic disease, Dr Pessagno's sweeping conclusion that it "can be in direct etiologic association with cancer does not seem to be justified by available evidence His advocacy of simple mastectomy as the procedure of choice in patients over 40 years of age is equally unwarranted —Ed]

Serous and Serosanguineous Discharge from Male Nipple. Norman Treves, Guy F Robbins and William L Amoroso Jr[1] (Mem'l Center for Cancer, New York) analyzed 30 cases of nipple discharge in the male observed at Memorial Hospital and 42 collected from the literature with special reference to the significance of nipple discharge as a symptom of carcinoma Nipple discharge occurred in 13 7% of all male patients with malignant lesions in the hospital and in 2 1% of those with benign lesions Their average age was 57 4 years Average age of patients in the collected series was 56 years This is within the general age range frequently reported

Average duration of symptoms before the patient sought treatment at the hospital was 26 9 months and median duration 12 months, compared with a median duration of 9 months for the total male breast cancer series in the same hospital Average duration of symptoms in patients with benign lesions was almost the same as in patients with malignant tumors, but mean duration was considerably shorter—7 months There was also much greater variation between duration of symptoms before treatment of individual patients who had benign lesions The size of the malignant tumors was somewhat smaller in the hospital patients

The type of discharge was sanguineous or serosanguineous in 75% of the collected series and in 82 2% of the hospital series with malignant lesions In patients with benign tumors, the discharge was predominantly, but not exclusively, nonsanguineous Discharge was an initial or an early symptom associated with other early symptoms in about 78% of all the cases and was a more frequent early observation than tumor, which was second in frequency as an early finding In the benign tumor groups, discharge was somewhat less common as an early or initial symptom

Duct lesions and papillomas predominated notably among patients with nipple discharge The frequency of papillomas is in striking contrast to their rarity in the total hospital male breast cancer series Papillomas are closely associated with sanguineous discharge in patients with both benign and malignant breast lesions The prognosis of patients with bleeding nipple associated with malignant lesions seems slightly poorer than in the total male breast cancer group

(1) A M A Arch Surg 73 319 329 August 1956

Nipple discharge in the male especially when sanguineous is to a striking extent associated with malignant tumors of the breast though it also occurs in patients with benign lesions While there are statistical differences between symptoms of benign and malignant lesions there are no certain clinical criteria to distinguish one type of lesion from the other Nipple discharge in the male should be considered suggestive of cancer until it is proved otherwise

Management of Intraductal Papilloma Its Relationship to Cancer of Breast is discussed by Martin A Howard and Millard S Rosenblatt[2] (Portland Ore) Intraductal papillary tumors are proliferations of duct epithelium which project outward into a dilated lumen from 1 or more areas A serous or bloody discharge is usually the symptom first noted The bleeding is often produced by injury to the papilloma, pieces of it break off inside the duct and the serous or bloody discharge carries it along the duct to the nipple Differentiation between papillary carcinoma and intraductal papilloma is readily made micro and macroscopically

The authors report on 159 instances of intraductal papilloma, in 105 it was associated with other benign pathologic conditions Papillomas plus carcinoma with metastasis occurred in 2 patients, papillomas plus carcinoma without metastasis in 16 Papillomas were single in 22 and multiple in 4 Only 1 patient's condition was diagnosed as carcinoma in situ in the intraductal papilloma Main clinical symptoms were masses nipple discharge tenderness and nipple deformity Since carcinoma occurs so infrequently with intraductal papilloma segmental resection of the involved portion of the breast with the offending duct is the procedure of choice

Paget s Disease of Nipple Clinical Review of 27 Cases Percy Helman and Murray Kliman[3] (London) did follow up studies on 27 women aged 31 75 with proved Paget s disease of the nipple The right breast was involved in 15 patients In no instance was the lesion bilateral Eczema or superficial ulceration of the nipple only was present in 15 patients eczema and a palpable lump in 11 and a palpable lump of 2 months duration with no obvious skin changes in 1 The lesion always involved the nipple and areola and often spread

(2) Am. J Surg 92 142 150 August 1956
(3) Brit J Surg 43 481 488 March 1956

to the skin of the breast tissue. In no instance was blood-stained discharge from the nipple duct recorded. The eczema not only persisted, but also sometimes recurred after periods of normal appearance.

There was no relation between duration of symptoms and survival time.

The prognosis following treatment of patients who had Paget's disease of the nipple without a palpable breast lump was uniformly good. When Paget's disease was accompanied by a palpable breast lump, prognosis was uniformly bad.

Nipple lesions in many instances may apparently heal but later they invariably break down and recur.

Carcinoma of Breast. Analysis of Factors Affecting Prognosis, Not Resulting from Treatment. W. F. Wassink[4] (Amsterdam) reviewed 658 breast cancers treated (radically or palliatively) or observed in the hospital of the Netherlands Cancer Institute from 1931 to 1945. No patient was lost sight of. Definite correlation was found between the length of waiting time, size of tumor, stage and survival time. Gradual improvement of the clinical material could be shown. Inoperable cases and stages with bad prognosis decreased in favor of cases with better prognosis, treatment remaining unchanged. Among operable cases, those without metastases in the axillary lymph nodes on microscopic examination increased, among those showing metastases, the percentage of the group with "limited" extension increased. This favorable trend is probably due to the average shortening of waiting time of breast cancer patients in the Netherlands, following greater alertness and willingness to seek medical help.

Study of clinical material should always be integral, inoperable cases being as valuable as operable cases, since they complement each other. Especially in cancer of the breast, observation time should be extended to 10-15 years. The average results achieved in a given area or country can seldom be obtained by using the patients of a special hospital, as this is not representative selection being unavoidable.

Breast Cancer: Influence of Treatment That Fails to Cure is discussed by Vincent P. Collins[5] (Baylor Univ.). Studying 507 patients treated by radical mastectomy who were not cured, Collins found that in 134, the first recurrence was in

(4) Arch. chir. neerl. 8: 296-312, 1956.
(5) Cancer 9: 1177-1181, Nov.-Dec., 195

the operative site in 109 on the chest wall and in 25 in the axilla Whether or not there were other distant metastases primary treatment failed to eradicate the disease in the treated area in 25% This generally agreed with the results of several authors, indicating a local recurrence rate for all cases of approximately 25% When disease was confined to the breast, incidence of local recurrence fell to less than 10%

In 79 patients the first sign of recurrence was in the supra clavicular lymph nodes Surgical and autopsy data indicated that the internal mammary lymph nodes were involved grossly or microscopically with comparative frequency First metastases in distant sites were observed in 373 of the patients In this group, distant metastases probably occurred before treatment, and outcome of the disease could not be influenced by local therapy

Of 425 patients with carcinoma of the breast followed to death, the commonest terminal condition was inanition with disseminated metastases Pulmonary metastases and pleural effusion with pulmonary insufficiency and pneumonia seemed most directly related to death In this group, 60% showed no recurrence at the primary site after radical mastectomy This was direct evidence of the effectiveness of this operation

It is felt that the primary treatment of breast cancer whether surgical or radiologic, exerts its effect in the area to which it is applied Local control or eradication of cancer in the primary treatment area may not effect cure or influence survival, but failure of local control means failure to cure Cure rates and survival rates indicate only that, throughout the world about 40% of breast cancers either grow locally and can be completely removed or grow so slowly that more than 5 years are required for recurrence to appear

Treatment of Operable Cancer of Breast David Lyall[6] (New York Univ -Bellevue Med Center) advocates radical mastectomy as early as possible The cancer field must be kept inviolate Dissection must be gentle, thorough and sharp and the wound must not be contaminated by cells liberated during biopsy Since the upper outer quadrant of the breast is the most frequent site for carcinoma, the axilla is the site of primary metastasis in well over half of breast tumors

(6) Surg Gynec & Obst 103 318 3?? September 1956

seen in the operable stage Postoperative irradiation is recommended to the anterior mediastinal and supraclavicular lymph nodes through 2 portals in selected cases. This treatment is begun as soon as the wound has healed in middle half cancers, lateral half cancers where the axillary nodes are involved, inflammatory cancers and those complicating pregnancy or lactation This radiation is probably rarely curative, but it slows tumor regrowth by locking viable cells in fibrous tissue and by obliterating lymphatic channels The operative area is not primarily irradiated, since this procedure is unnecessary and potentially harmful If good cancer technic is followed, incidence of local skin recurrence should be about 6%, not enough to recommend the procedure Surgical castration is advised in women who are actively menstruating However, this is done with restraint and with the feeling that the procedure is merely palliative, that it does not alter the final result if cancer persists, but that it does slow down tumor regrowth and gives the physician more latitude for other hormone therapy in terminal stages of the disease

Biopsy of Breast Followed by Delayed Radical Mastectomy is discussed by E Harris Pierce, O Theron Clagett, John R McDonald and Robert P Gage[7] (Mayo Clinic and Found) Among 650 patients on whom mastectomy was performed at the Clinic during 1947 and 1948 were 104 who had undergone biopsy at an appreciable interval before mastectomy, 96 of whom made up the biopsy study group, 554 patients constituted the control group There 95 women and 1 man, with an average age of 48 2 years

The types of biopsy were incisional (39), punch (1), Vim-Silverman needle (1) and excisional (55) Definitive surgical treatment was performed in 2 weeks or less after the initial biopsy in 34 4%, in 1 month or less in 76% and in 6 months or less in 89 6% Eighty-three patients had adenocarcinoma 10 comedocarcinoma and 3 Paget's disease Axillary nodal metastasis occurred in 44 8% of the patients at time of operation

The over-all 5 year survival rate is 61 1% for the biopsy group and 60 1% for the control group The rate is only 47 5% for patients who had incisional biopsy, compared with 70 9%

(7) Surg Gynec & Obst 103 559 564 November 1956.

for those who had excisional biopsy Of patients delaying definitive treatment up to 6 months, 65 1% were alive 5 or more years after mastectomy

► [It is possible that the difference in survival rates between the group having incisional biopsy as compared to the group having excisional biopsy is predicated more on the nature of the lesion than on the surgical procedure It appears likely that excisional biopsy would most often be performed for small localized lesions —Ed]

Cancer of Breast: Surgeon's Dilemma is discussed by George Crile, Jr[8] No proof is yet available that results of radical mastectomy are better than results of simple mastectomy or that the course of breast cancer is influenced by any form of surgery So little is known about the ways of cancers and the complex relationships of tumors to their hosts that theoretic considerations based on the traditional concept of the spread of cancers are of little value

McWhirter subjected more than a million people to a careful clinical experiment All persons with breast cancer in this group were included, regardless of how they had been treated or whether they had not received treatment The study suggests that in some instances radical mastectomy *may shorten the survival period In all operable stages* of the disease, McWhirter found that results of simple mastectomy were superior to those of radical mastectomy Furthermore, x-ray therapy given after radical mastectomy reduced the incidence of local recurrence, but made no significant change in survival rates However, when treatment was changed from radical to simple mastectomy, with irradiation given in both instances, the survival rates at 5 years and at 10 years after operation were increased by more than 10% McWhirter believes that by not dissecting the axilla, dissemination of disease is avoided and survival rate increased

Others have suggested taking biopsy specimens of mediastinal and supraclavicular lymph nodes before performing a radical mastectomy and advised that when the supraclavicular lymph nodes are involved treatment should be solely by irradiation Results with this method are reported to be excellent, because surgery is not done on the types of cancer that an operation is apt to spread Evidence is mounting that the regional lymph nodes, even when involved by cancer, may act more often as a barrier to further spread than as a

(8) Cleveland Clin Quart 23 179 185, July, 1956

source of dissemination. Thus, to draw an analogy between the role of the lymph node in infection and in cancer seems appropriate In a hand infection, the axillary nodes are viewed as a barrier to systemic spread The local lesion is treated and the natural resistance of the body counted on to overcome the bacteremia and lymph node involvement. Excision of infected lymph nodes would spread the disease. Yet, in grade IV cancers, when blood vessels and lymphatics are filled with tumor cells, many surgeons feel it is necessary to excise the lymphatic barrier.

Lack of attachment to surrounding cells and ability to migrate by ameboid movement causes migration and exfoliation of cancer cells into the streams of body fluids Spread of the cancer, therefore, depends much more on resistance of the host and ability of the circulating cells to implant and to grow than on the type of surgical treatment.

The principle of local excision or destruction of a cancer within the lymph node barrier has been used for many years in treatment of cancers of the lip, skin and mouth, where treatment of clinically uninvolved lymph nodes often is deferred until the course of the disease has been evaluated Survival rate following simultaneous dissection of the primary melanoma and palpable lymph node metastases is almost nil, yet nearly one-half of the patients have been reported to survive more than 5 years when the primary lesion is first removed and involved nodes are resected later It is more important to determine early which lesions are adapted to surgery than to operate early and as widely as possible

In clinical stage II cancers with palpable axillary nodes, if the history is short, treatment is simple mastectomy and irradiation by the McWhirter technic If the primary tumor has been present a year or more or is in the upper outer quadrant and if palpable nodes are few and movable, radical mastectomy is performed

Since evidence shows that irradiation can do harm as well as good, Crile believes that it should not be applied prophylactically as a routine measure Even endocrine therapy is not without danger Adrenalectomy has been shown to stimulate growth of breast cancer, as has administration of androgens Even oophorectomy is not free from this danger and should not be applied indiscriminately Some young women

have breast cancers that depend not on estrogens but rather on the growth or on the mammotropic hormones of the pituitary, which may be cross-stimulated by oophorectomy Except for removal of the pituitary, there are no operations, *technics of irradiation or treatments with sex hormones that* are free from the risk of accelerating the growth of breast cancer Until a better understanding of the factors that control the spread of cancer is developed, therapeutic generalizations should be avoided and treatment should be based on the biologic behavior and response to treatment of the individual cancer

► [At the present time there are two divergent trends in treatment of cancer of the breast The first, exemplified by the studies of McWhirter, is toward limitation of the extent of the surgical procedure and increased utilization of irradiation therapy, while the other, exemplified by the reports of Dr Wangensteen is toward a more radical and extensive surgical procedure This problem is not yet solved and final opinions cannot be rendered It is possible that the combination of surgery and a chemotherapeutic agent may prove valuable in the future Each new report should be critically evaluated The evidence to date is sufficient to raise questions concerning the selection of patients for radical mastectomy, but at present it would appear that standard radical mastectomy combined with irradiation when axillary nodes are involved remains the treatment of choice —Ed]

Treatment of Cancer of Breast Local Mastectomy or Radical Operation? F Froehlich[9] (Strasbourg) notes that though most surgeons follow the rule that cancer of the breast must be treated by radical operation with or without x-rays, depending on its stage, others have been struck by the unexpected survival, as long or longer, of patients who had minimal operations, e g , merely biopsy

More and more good results are being reported with less radical operations in tumors classified as operable A patient with cancer of the breast accompanied by axillary metastases has *despite an extensive operation*, a *minimal* chance of living 5 years It seems preferable to subject advanced cases to radiotherapy and confine surgical treatment to simple removal of the tumor

Froehlich performed simple mastectomy in 55 cases As a rule, the maximum size of the tumor was that of a mandarin orange the tumor was adherent to the skin, but relatively free in the deep plane All patients had postoperative irradiation, except a few who refused Resections were made electrosurgically outside the limits of the tumor No cancerous

(9) Lyon chir 52 179 186 1956

tissue was found histologically at the surface of any sections There were no complications following operation

Radiotherapy administered after 3 weeks consisted of 3,000 r to both subclavicular and axillary fields and tangential radiation to the breast, 2,000-3,000 r Daily dose was 250 r to each of 2 fields Course of treatment was 1 month to 6 weeks

Of 31 patients operated on over 5 years ago, 7 are dead, 2 of these survived 3 years and 2 for 5 years One patient, 5 years after operation, had a local recurrence which was easily removed Hence, 24 of 31 patients are living 5-9 years after simple mastectomy These results, which agree with those of much larger series, e g, McWhirter's, encourage extension of the indications for local mastectomy

Treatment of Carcinoma of Breast is discussed by Robert McWhirter[1] (Royal Infirm, Edinburgh) In every published series of cases in which radical mastectomy is used there is a striking fall in survival rate when the axillary nodes are involved The explanation for this decrease is that either the supraclavicular or the internal mammary nodes may be involved in 60% of cases with axillary involvement The cause of the high failure rate in the conventional radical operation is thus obvious, because when spread has occurred to the axilla the operation must fail in at least 60% of cases To get better results, treatment—either surgical removal or irradiation—must be extended to the supraclavicular and internal mammary nodes

In Edinburgh the following approach is used In operable breast cancer, the breast is removed by simple mastectomy, and about 10 days later irradiation of the supraclavicular, internal mammary and axillary regions is started, not less than 3,750 r being given in 3 weeks Edema of the arm is uncommon However, this procedure is contraindicated in stout patients in whom it is impossible to deliver an adequate dose of x-rays to the axillary lymph nodes, in gross peripheral vascular disease of the upper limb, when axillary tail of the breast is involved and the primary tumor is in continuity with mobile axillary nodes, and in the elderly patients and patients incapacitated by intercurrent disease With this approach, crude 5- and 10 year survival rates of 58% and 39% have been obtained

Patients with fixed axillary nodes or palpable supraclavicu-

(1) Irish J M Sc pp 475 483 November 1956

ar nodes may still have the breast removed surgically, followed by a full course of radiotherapy Chance of cure thus can be offered to far more patients than is possible by radical mastectomy

McWhirter believes that radiotherapy will, in the presence of less gross involvement of the lymph nodes, i e in operable patients provide results at least comparable to those obtained by surgical dissection

Parasternal Dissection in Radical Mastectomies with Follow-up Study Mammary carcinoma may metastasize by the parasternal route, but this has been considered rare secondary to other metastases and occurring late T Tobiassen B Sørensen and E Hasner[2] (Copenhagen) find that parasternal invasion is common, especially when the tumor is localized in the medial part of the breast, and especially where other nodes are invaded Parasternal metastases are seen in cases of early lymphatic spread and may be seen before invasion of other nodes This means that the parasternal route is invaded in many patients ordinarily treated with classic radical mastectomy

The authors reviewed results of two series of mastectomies The first was treated with mastectomy including parasternal dissection the second with radical mastectomy, *including* supraclavicular and parasternal dissection In the second series parasternal nodes were not so grave prognostically as in the first Results in the second series were better than in the first This was probably due to the supraclavicular dissection and more efficient parasternal dissection

Another Look at Superradical Operation for Breast Cancer In 1948 Owen H Wangensteen[3] (Univ of Minnesota) tried an extension of the usual operation through the 1st rib and the clavicle to encompass more regional lymph nodes in each direction exposing the area so as to perform a supraclavicular cervical and upper anterior mediastinal dissection together with excision of the homolateral internal mammary chain of lymph nodes as well as the conventional radical mastectomy

Resultant respiratory difficulties and deformity and the advanced age of some of the patients contributed to the au

(2) Acta chir scand nav 111 456-464 1956
(3) Surgery 41 857 861 May 1957

thor's changing to a 2-stage procedure for the extended operation In the first stage, the usual Halsted operation was done, combined frequently with excision of a segment of the 1st rib Four to 6 weeks later the supraclavicular, internal mammary and mediastinal dissections were performed But the 2-stage procedure has obvious disadvantages, and the search continued for an acceptable manner of performing a 1-stage operation

Dr Wangensteen's present operation consists of a single long oblique to transverse incision beginning beneath the axilla and extending slightly downward, crossing the midline, with elliptical sacrifice of skin over the breast and neoplasm (this precludes contracture which delimits motion in arm) The conventional Halsted operation is first done Wide undercutting of the skin flaps permits ready access to the neck and exposes the ensiform cartilage in the epigastrium The sternocleidomastoid muscle is cut free from the clavicle, and the sternal end of the clavicle is disarticulated, permitting the clavicle to be swung outward and up or down as required, and eliminating any subsequent deformity The entire sternum is then split in its midline and the attachment of the scalenus anticus tendon to the first rib is cut free

The advantages are that (1) it is a 1-stage procedure, (2) an oblique to transverse incision eliminates the hazard of necrosis at the lower margin of the medial skin flap, and (3) complete splitting of the sternum provides only 2 bony segments which need to be rewired This insures a stable, bony thorax and precludes respiratory embarrassment This technic permits excision of the internal mammary lymph node chain throughout its entire length, including also the node not infrequently the seat of metastatic cancer at the origin of the internal mammary artery from the subclavian artery

The operation is performed as 4 dissections with 4 excisions (1) breast and axillary contents, (2) internal mammary artery and vein accompanying lymph node chain, (3) upper mediastinal dissection removing portion of thymus and the fat and lymph node-bearing tissue adjacent to the innominate veins and (4) low supraclavicular neck dissection removing lymph node bearing tissue under the omohyoid muscle with clearing of the internal jugular vein and the site of confluence of jugular, subclavian and innominate

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veins Use of postoperative roentgen therapy is advisable

In the author's clinic this operation is done now in all medial malignant lesions of the breast and in all patients with axillary metastases at time of operation, its risk being essentially that of the Halsted operation

Critical Analysis of Palliation Produced by Adrenalectomy in Metastatic Cancer of Female Breast. Charles P Perlia Sydney Kofman, Devanaboyina Nagamani and Samuel G Taylor[4] (Chicago) report that of 58 patients with metastatic cancer of the breast, 8 died in the immediate postoperative period, extensive metastatic pleuropulmonary involvement caused death in 5, 2 died of hepatic insufficiency secondary to metastatic disease and 1 from postoperative hemorrhage In the other 50 patients worthwhile palliation was obtained in 13 (26%) 3 showed objective regression due to the procedure *but worthwhile palliation did not occur* Menstrual age and response to adrenalectomy could not be correlated No accurate estimation of prognosis could be obtained by comparing results of previous therapy with those after adrenalectomy

Osseous metastases in mammary carcinoma are predominantly osteolytic, but a lesion may not be demonstrable until 40% of the bone has been destroyed The x ray manifestations of remineralization of osteolytic lesions are poorly understood, some authors feel they are of little value as an objective criterion In analysis of serial chest films other pathologic conditions such as perifocal exudative changes pneumonitis or atelectasis may be interpreted as neoplastic lesions and their clearing wrongly attributed to a regression of carcinomatous metastasis Gross shrinkage of soft tissue metastases, lymph nodes and re epithelization are often dramatic and are taken as convincing evidence of the efficiency of therapy But, although they are uncommon and unsupported by good control studies spontaneous regressions are known to occur and the observed changes may be due to inhibition of secondary inflammatory changes or to effects on the stromal component of the lesion Other factors such as secondary infection or delayed healing, are of some importance in pathogenesis of rampant ulcerative lesions and must be considered in analyzing results of adrenalectomy Thus evaluation of objective regression of metastatic breast tu-

(4) Ann Int Med 45 989 1000 December 1956

mor is difficult, and conclusions may prove to be erroneous

Adrenalectomy and Hypophysectomy for Advanced Cancer of Breast: Comparative Study. For the past 3 years adrenalectomy or hypophysectomy has been considered for all patients with advanced breast cancer in whom the possibilities of direct surgery, irradiation and hormone therapy were exhausted Results in 60 patients are reviewed by H J. B. Atkins, M A Falconer, J L Hayward and K S MacLean[5] (Guy's Hosp , London)

Both operations increase certain hazards Maintenance therapy must be carefully supervised and the closest cooperation demanded between hospital and practitioner. In hypophysectomies, serum cholesterol is estimated at intervals to assess thyroid function Electrolyte studies are done in patients in whom incipient adrenal deficiency is suspected clinically The standard cortisone dose is 25 mg twice daily orally, with substantial increases at the time of acute infection or accident An implant of 300 mg deoxycortone acetate before discharge from the hospital usually prevents mineral imbalance

To minimize the possibility of epileptic fits, all patients with hypophysectomies received 30 mg phenobarbitone twice daily for a year Diabetes insipidus usually developed within a week of the hypophysectomy and cleared spontaneously between the 4th and 11th months Satisfactory control was usually obtained by insufflation of posterior pituitary snuff 1-3 times daily

Thirty patients submitted to each of the operations Those with hypophysectomy lived an average of 4 months longer than those with adrenalectomy The longest survival after hypophysectomy was a year longer than the longest survival after adrenalectomy These findings suggest that if ablation of endocrine tissue is indicated in a patient with advanced breast cancer, hypophysectomy is preferred to adrenalectomy with oophorectomy The results are not statistically significant and are suggestive rather than conclusive Neither procedure appears to hold significant promise for permanent cure

Hypophysectomy in Treatment of Advanced Cancer of Breast Bronson S Ray and Olof H Pearson[6] (New York)

(5) Lancet 1 489 496 Mar 9 1957
(6) Ann Surg 144 394 406 September 1956

performed 75 hypophysectomies in 74 women with advancing mammary carcinoma There were 7 deaths in the first 30 days after operation, though only 3 could be directly attributed to the operation Of the 67 patients who survived operation, 36 had objective remission of their disease and 31 had no benefit Every patient temporarily benefited by castration had a new remission after hypophysectomy, and 4 of 11 patients with both castration and adrenalectomy obtained a new remission from hypophysectomy. If hypophysectomy is not used as the initial ablative operation in altering endocrine influence on the disease, it is probably preferable to adrenalectomy as a second operation following castration Survival was more than twice as long in patients who obtained remission after hypophysectomy than in those who did not, and the difference should be even greater when more time has elapsed

Ablation of pituitary function was applied only in patients with widespread metastatic disease Prognosis is fairly well established in women who have metastases to regional lymph nodes when the breast lesion is first discovered or operated on In this group, "prophylactic" castration has a salutary but temporary effect What might be the benefits if hypophysectomy were employed in the early stages, as castration has been, before the disease becomes widespread and possibly changes character through development of autonomy of the secondary lesions?

Hypophysectomy in Advanced Breast Cancer In breast cancer, maintenance and growth of the tumor appear to depend on hormone factors of the ovaries, adrenal glands and pituitary gland No one of these factors alone is the major one Yet the relative imbalance of the hormone status attained by administration or deprivation of hormones may be as important as the total withdrawal or administration of specific agents Invariably, breast cancers that regress after hormone alteration eventually undergo reactivation *Total* hypophysectomy was attempted in patients with advanced breast cancer because estrogenic, androgenic and growth hormones are under certain physiologic conditions, a stimulus to growth of breast cancer Removal of the pituitary gland eliminates the stimulating factors and induces another hormone imbalance

B J. Kennedy, Lyle A French and William T Peyton[7] (Univ of Minnesota) performed total hypophysectomy on 28 patients with advanced breast cancer Objective clinical regressions, up to 20 months, were seen in 18 patients; 2 others showed decreased rate of tumor growth At the time of report, 13 patients were alive Average survival of patients demonstrating tumor regressions far exceeded that of those without improvement All patients of this series who underwent castration for metastatic breast cancer and had shown response to castration, when the disease progressed, had regression after hypophysectomy

Hypophysectomy eliminates the pituitary hormones and profoundly suppresses ovarian and adrenal function in a way comparable to removal of these glands In view of the favorable responses after hypophysectomy, adrenal atrophy and the ease in managing the patients, hypophysectomy seems preferable to adrenalectomy in treatment of advanced breast cancer There is yet insufficient evidence that hypophysectomy should be employed as the initial endocrine treatment for patients with metastatic breast cancer

Eventually, breast cancers regressing after hypophysectomy undergo reactivation Since a pharyngeal pituitary gland has been described in over 90% of autopsies, in patients with destroyed activity of the pituitary gland it is possible that the pharyngeal pituitary undergoes alterations and serves as an endocrine organ

► [Increasing experience with hypophysectomy in the treatment of metastatic breast cancer leaves little [illegible]

each patient for the majority can be satisfactorily managed by nonoperative means —Ed]

Advanced Mammary Cancer Treated with Sex Hormones Edward F Lewison, Frances H Trimble and Robert S Ganelin[8] (Johns Hopkins Univ) gave 133 patients 223 complete courses of sex hormone therapy for advanced mammary cancer The choice between estrogen and androgen was made principally in relation to the physiologic age of the patient in reference to her menopause Estrogens were used only after 5 years had passed since the menopause, whereas androgens were useful in premenopausal and postmenopausal

(7) New England J Med 255 1165 1172 Dec 20 1956
(8) J A M A 162 1429 1437 Dec 15, 1956

patients However, in the definitely older patients estrogen was the hormone of choice

A favorable objective response occurred with estrogen therapy in 40% of patients with primary tumors 31% with soft-tissue lesions 32% with visceral lesions and 17% with osseous lesions Stilbestrol and ethinyl estradiol were superior to chlorotrianisene (TACE®) A favorable objective response occurred with androgens in 27% of patients with primary tumors 23% with soft tissue lesions, 15% with visceral lesions and 11% with osseous lesions There appeared to be no significant difference in objective therapeutic effectiveness between the several androgens used The optimum dose of testosterone propionate was 50 100 mg given intramuscularly 3 times weekly Complete or partial relief of pain occurred in 52% of patients treated with androgens and in 51% treated with estrogens Stanolone seemed better than testosterone propionate in subjective relief of pain A sense of well-being occurred in 48% of patients treated with androgens and in 44% treated with estrogens Regression of the tumor sometimes occurred also on discontinuance of hormone therapy that was ineffective or had ceased to maintain an initial improvement

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THE THORAX AND MEDIASTINUM

Two Unusual Congenital Anomalies of Thorax (1) Supernumerary Ribs and (2) Abnormal Intrathoracic Fascial Band, Review of Literature About 1% of all persons have *some variation from the normal pattern of 12 pairs of* thoracic ribs Most of them will have extra ribs in the cervical or the lumbar *region* The *ribs may* be single or paired In the unilateral minority they are more common on the left side Bifid or forked ribs are not rare

John K Stevenson and K Alvin Merendino[9] (Seattle) report 2 cases of anomalies not previously described

CASE 1 —Girl 17 with a diagnosis of asymptomatic atelectasis of the lower lobe of the right lung had a history of pulmonary tuberculosis on the right side A chest x ray showed a shadow of a solid opacity on the right extending from the 7th rib down in a triangular fashion from the hilus to the lateral edge of the diaphragm Three

(9) J Thorac c Surg 3? 5?1 5 7 October 1956

"accessory" ribs on the right at the level of the 7th cervical and the 6th and 7th thoracic vertebrae were demonstrated. Further diagnostic studies, including bronchoscopy, bronchograms and multiple x-rays, failed to establish a diagnosis. On posterolateral exploratory thoracotomy, the cervical rib on the right could not be palpated or demonstrated. The accessory ribs at the level of the 6th and 7th thoracic vertebrae extended from their articulation on the vertebral column ventral and slightly caudal to the normal rib articulation. They extended downward and ventrally for 8 and 11 cm., respectively, and at their termination projected into the thoracic cavity, 1.5 and 2 cm. beyond the normal wall contour. Their exposed surfaces were covered normally with parietal pleura. There was attachment of the diaphragm to the medioventral surfaces of the accessory ribs at the level of the 6th and 7th thoracic vertebrae at the vertebral column. From this attachment, the diaphragm extended downward and outward in the form of half a cone to a normal peripheral attachment at the base. It was assumed that this abnormal "tenting" of the diaphragm accounted for the abnormal x-ray findings.

CASE 2.—Man, 39, underwent surgery for correction of mitral stenosis. Mitral commissurotomy was performed through a left lateral incision. An incidental finding was a firm, hard tendinous band, about 1.5 cm. in diameter and 14 cm. long, extending from the apex of the thoracic space from its apparent attachment to the undersurface of the 2d rib anteriorly down to the tendinous central portion of the dome of the left hemidiaphragm. This tendinous structure was completely circumscribed by invaginated lung and covered by visceral pleura. There was relatively complete fixation of the left hemidiaphragm due to the tendinous attachment. The structure was excised, releasing the diaphragm, and the operative wound closed.

Microscopic sections of this fibrinous band showed it to be almost completely acellular with hyalinization of fibers, producing homogenization in many areas so that evaluation of architecture was impossible. However, the over-all structure resembled old hyalinized tendon exhibiting focal areas of calcification. It was impossible to detect whether or not the tendinous structure actually terminated at its apparent attachment to the 2d rib or extended into the neck to the level of the 3d or 4th cervical vertebra. Probably, this structure remained as an unresolved remnant of the cranial-dorsal attachment of the septum transversum on the left and was extended into the configuration found by the process of growth and development described here. The fibrous tendinous band was not shown by chest x-ray, which accounts for its not being discovered earlier.

Operative Treatment of Funnel Chest is difficult. Several methods and modifications have been developed, but the late results have not always met expectations. F. Rehbein and H.-H. Wernicke[1] (Bremen, Germany) used the following technic in 12 children, aged 4-14.

(1) Arch. Dis. Childhood 32:5-8, February, 1957.

METHOD—The funnel chest is mobilized and narrow metal blades are pushed into the rib like marrow-nails The sternum and cartilages are elevated, the blades crossed and depressed The sternum is fixed elastically with a wire sling at the crossing point The separate cartilage segments may also be suspended (Fig 10) Costal cartilages which first have been resected are now adapted loosely by means of sutures Deformities of an asymmetrical type with an oblique sternum also may be so fixed

Only once was it necessary to split the sternum The fixation is solid and stable, particularly when the metal blades reach the other side The chest wall cannot be depressed It

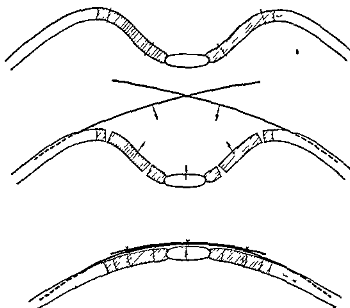


Fig 10—Stabilization of elevated funnel chest with crossed metal blades (Courtesy of Rehbein, F, and Wernicke, H H Arch Dis Childhood 32 5 8, February, 1957)

is suspended like a garland and splinted until completely healed Slightly deformed chests require only one pair of blades Deep funnels in older children may require up to three pairs of blades

All patients had an uneventful recovery After 6 months the blades were removed In most patients, removal of the blades did not spoil the good results The best results were obtained with a deep funnel, the edges of which were not far apart

Value of Supraclavicular Deep Lymph Node Biopsy at Intrathoracic Lesions is discussed by Poul Ottosen, Jytte Flygenring and Tyge Søndergaard[2] (Aarhus, Denmark)

(2) Acta chir scandinav 111 275 277, 1956

Biopsy specimens were taken from the deep cervical lymph nodes and lymph nodes of the upper anterior mediastinum of several patients with intrathoracic lesions, for diagnostic as well as prognostic purposes, the latter in relation to operability The authors not only removed the deep cervical lymph nodes from the fat pad in front of the anterior scalenus muscle, but also explored the upper anterior mediastinum to palpate and remove possible enlarged lymph nodes Usually the operation was performed on the side of the intrathoracic lesion A right-sided approach was generally used for bilateral lesions

In all but 1 of 76 patients studied lymph nodes were found and removed for microscopic examination Of 52 diagnostic biopsies, the result was positive in 16

Of 24 patients with histologically verified bronchogenic carcinoma, 3 had metastases to the deep cervical nodes Of the other 21 patients, 19 underwent thoracotomy, and 8 of these had lesions which were inoperable for various reasons The number of patients inoperable because of lymph node involvement of the upper anterior mediastinum cannot be estimated from present material Thus, an estimation of the frequency of biopsy failure is not possible

Benign Thymoma and Agenesis of Erythrocytes Edwin D Bayrd and Philip E Bernatz[3] (Mayo Clinic and Found) review 12 cases of thymic tumor and anemia reported since 1928 and add 2 new cases The tendency to selective severe suppression of erythrogenesis was noted in all the patients In addition, granulocytopenia developed in 3 and thrombocytopenia in 4 Splenomegaly was found in 3 and agammaglobulinemia in 1 Typically, bone marrow examination revealed few or no erythrocyte precursors Myelopoiesis and megakaryocytes usually were ample, "small, dark lymphoid cells" also were observed

Thymectomy alone resulted in complete restitution of marrow and blood to normal in 2 patients (a woman and a man), 1 had hypoplasia, while the other had severe red blood cell aplasia Two other patients were somewhat benefited by thymectomy and ultimately rehabilitated by subsequent splenectomy and steroid therapy When all else fails, life may be prolonged for some years with blood transfusions, although

(3) J A M A 163 723 727 Mar 2 1957

in time hemosiderosis and hemochromatosis will ensue

In the authors' patients, both men, aged 68 and 58, thymectomy was not successful Both showed the typical blood picture In the first, the tumor was an encapsulated, lobulated thymoma of small cell type, measuring 8×7×4 5 cm Failure to elicit immediate reticulocytosis postoperatively apparently presaged failure of the anemia to respond, transfusions alone sustained the patient for 5 months In the second, cortisone was tried without effect, but the patient still refused operation The following year, however, a thymoma was removed by the patient's physician, but this did not improve the hematologic status Two years later, he required 500 cc whole blood every 8 10 days He showed evidence of hemosiderosis and his condition was slowly deteriorating, but he had declined to undergo splenectomy

Thymoma. Review and Reclassification The term thymoma with modifying nosologic designations has been applied to many mediastinal tumors of varying morphologic pattern Elaborate classifications have been erected from relatively small series of cases These classifications generally attempt to fit particular examples into embryologic or histogenic categories However, in neoplasia, the thymus displays such wide variation as to conform to none but the broadest definitions

Lalla Iverson[4] (Armed Forces Inst of Pathology) reviewed 27 true thymomas classified in two histologic subgroups related to the presence or absence of symptoms of myasthenia gravis in the patient Each example is generally a composite of various elements typical of the group in varying proportions (1) Thymomas in patients without myasthenic symptoms are characterized by stage of lymphoid, spindle cell or stromal proliferation (2) Thymomas in patients with myasthenia gravis are characterized by large, pale epithelial cells, loosely mixed with lymphocytes and often arranged in cords or clusters around vessels The close correlation of myasthenia gravis with epithelial cells around vessels in the thymoma suggests an endocrine function for the type cell

In this series most cases previously diagnosed as thymic carcinoma were seminomatous tumors of the mediastinum

(4) Am J Path. 32 695 719, July Aug, 1956

These may be differentiated from thymomas by the histologic characteristics of the type cell, the frequently accompanying granulomatous reaction, their radiosensitivity and evident malignancy

Iverson also reports 5 cases of localized hyperplasia of mediastinal lymph nodes The lesion is a nonspecific reaction, histologically benign and characterized by alterations of the germinal centers simulating Hassall's corpuscles It is frequently misdiagnosed as thymoma

Tumors of the Diaphragm are rare Of 44 reported tumors, 22 were benign and 22 malignant The commonest types are lipoma and fibrosarcoma, but secondary carcinoma and sarcoma have also been reported There are no characteristic signs or symptoms of diaphragmatic tumor A mass may be palpable and may be accompanied by pain, usually thoracic but sometimes abdominal However, the tumor may be asymptomatic and be discovered on routine x-ray examination X-rays can lead only to a provisional diagnosis When a mass in the diaphragm is suspected, thoracotomy is indicated, but laparotomy may also be needed

Frank Nicholson and Raymond Whitehead[5] (Univ of Manchester) describe a patient, aged 11, who was hospitalized because of an enlarged abdomen At surgery, an undifferentiated malignant tumor was found in the diaphragm It resembled a blood-filled sponge and consisted of small round and oval cells Possible diagnoses included angioendothelioma, sarcoma and neuroblastoma The growth could have been primary or secondary The tumor was resected, with relief of symptoms, and recurrences disappeared after x ray therapy, but the child died 15 months after clinical diagnosis Autopsy was not performed

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THE LUNGS AND PLEURA

Six Cases of Traumatic Rupture of Bronchus in children are reported by Michael Bates and Harvey J Beard[6] (Norfolk, England) Two had had atelectatic lungs for many

(5) Brit J Surg 43 633 637 May 1956
(6) Thorax 11 312 323 December 1956

years, 1 had pneumonectomy within 2 weeks of an accident 2 have healthy, functioning lungs after late operative repair of the injured bronchus and 1 patient made a satisfactory spontaneous recovery Late operative repair consisted of end to end anastomosis of the torn bronchus, resulting in full re-expansion of the lung

Mediastinal emphysema should always be regarded as evidence of rupture of the tracheal, bronchial or, more rarely, esophageal wall X-ray study will reveal in most instances a pneumothorax though this is not an essential feature Hemoptysis is infrequent and was not observed in this series In patients with a suspected bronchial injury, bronchoscopy should be performed

When operation is indicated in a patient with traumatic rupture of the bronchus, it should be performed early If this is not practicable and atelectasis of the lung supervenes then open operation for repair of the bronchus should be undertaken, even though the atelectasis is of some months duration

Tracheal Reconstruction was studied experimentally in dogs by John M Keshishian, Brian Blades and Edward J Beattie, Jr[7] Tissue grafts, steel wire coil and tantalum and stainless steel mesh were used Results were not satisfactory when rigid prostheses were used and when the entire circumference of the trachea was replaced However, when only the anterior wall or the posterior wall was replaced, incidence of stenosis decreased Stainless steel mesh appears to be a satisfactory prosthetic material because of its tissue acceptability, *flexibility and incorporation by body tissues*

Tracheal reconstruction was done on 9 patients Stainless steel mesh was used as a prosthesis in 5 A steel coil spring prosthesis was used in 1, and plastic procedures to restore continuity sufficed in 3 In 1 patient, use of the stainless steel prosthesis was unsuccessful, in another, death occurred after erosion of a great vessel

The authors suggest that, when possible, tracheal defects should be sutured Simple plastic procedures are satisfactory for short *stenotic segments* When a prosthesis is used, proximal tracheotomy is mandatory and stainless steel mesh is recommended

(7) J Thoracic Surg 32 707 727, December 1956

Clinical Evaluation of Decortication in 172 cases is made by David H. Waterman, Sheldon E. Domm and William K. Rogers[8] (Knoxville, Tenn.). In 70 cases decortication alone was done; in 49 it was combined with lobectomy, in 38 with segmental resection, in 10 with thoracoplasty, in 3 with diaphragmatic herniorrhaphy and in 2 with plication of the diaphragm. Of 115 patients with tuberculosis, 39 had unexpandable pneumothorax lung, 55 had restricted lobe or lobes limiting expansion at resection, 8 had restricted lobe at thoracoplasty for postresection residual space, 6 had tuberculous effusion and 7 had tuberculous empyema. The nontuberculous indications for decortication were hemothorax (21), chronic empyema (4), chronic empyema with calcification (2), empyema following resection (4), empyema following ruptured lung abscess (2) spontaneous pneumothorax (7), bronchiectasis (3), and bullous emphysema, partial agenesis of the lung, diaphragmatic hernia and chylothorax (1 each). There were 10 patients with malignancy, including 5 with uncontrollable pleural effusion secondary to metastatic malignancy and 5 with restricted lobe or lobes secondary to bronchogenic carcinoma.

An intercostal incision is the most satisfactory. Removal of the parietal pleura as well as the visceral peel is done if sufficient parietal pachypleuritis is present to interfere with return of chest wall motion. The diaphragm is mobilized to its origin and decorticated, if possible, to permit maximum return of excursion. All adhesions are freed, fissures developed, and infolding of the lung corrected by removal of overlying webs of peel. The phrenic nerve must not be injured. To prevent prolapse, the lung is tacked into optimal position with several catgut sutures. Air leaks should be avoided Selective breathing exercises are very important postoperatively.

The incidence of complications was 13.8% in cases in which decortication was combined with resection and 15 3% in cases without resection. There were 4 deaths, 1 from operative hemorrhage, 1 from postoperative hemorrhage and 2 from pulmonary insufficiency. Of 139 followed, 77.7% had good results, 14.4% had fair results and 7.9% (including the deaths) had poor results

(8) J Thoracic Surg 33 1 16 January, 1957

Bronchospirometric studies demonstrated technically satisfactory tracings on a group of 7 tuberculous patients, 5 of whom had "false re expansion", i e, unilateral unexpandable pneumothorax lung without space

The final results of decortication depend not on the disease for which it was done but on the functioning potential of the underlying imprisoned lung and the technical success of the surgical procedure

Bronchial Fistulas Following Lung Resection Postoperative bronchial fistulas are defined by Olivier Monod and Brigitte Weyl[9] (Paris) as pathologic communications between the pleural (thoracic) cavity and the bronchial tree developing after pulmonary resection, becoming chronic and showing no tendency to heal spontaneously This definition excludes fistulas of the lung parenchyma in which the bronchi present no macroscopic lesions The latter persist for a short time only and heal spontaneously It is felt that postoperative bronchial fistulas are caused by the close contact of the bronchial sutures with infected tissues not affected by antibiotics and to pathologic changes in the bronchial wall itself

Conservative treatment of postoperative bronchial fistulas is rarely effective and suggested only in inoperable patients There are several surgical approaches close the fistula mechanically from the outside (thoracoplasty), cover it (with placentar or muscle tissue) resuture it after renewed wound care or resect it with the lung parenchyma around it to get better healing proximally All involve technical difficulties Finding the fistula and caring for the bronchial stump require great skill Postoperative fistulas developing after lobectomy or segmental resection may be located either in the resected stump or on any other bronchus, sometimes rather removed from the resection site The latter is usually quite small After pneumonectomy, it is especially difficult to reach the fistulous main bronchus since it may be retracted far into the mediastinums For a better approach, the authors developed a technic which after resection of a few intercostal arteries permits the temporary displacement of the aorta and an easier access to the tracheal bifurcation

The type of surgical repair of a postoperative fistula de

(9) Thoraxchirurgie 4 197 214 October 1956

pends on the location of the fistula, time of onset and physical condition of the patient If a fistula develops after lobectomy or segmental resection, an attempt should be made to rehabilitate the remaining lung parenchyma or use it in filling the thoracic space However, saving lung parenchyma which has no adequate blood supply should be avoided If a fistula develops shortly after surgery on the upper lobes, drainage may be successful within 10 days postoperatively This is followed, if necessary, by a thoracoplasty. Fistulas developing late after surgery require thoracoplasty with renewed suturing of the bronchial stump, or if indicated by the remaining lung parenchyma, pneumonectomy in some patients

The rare fistulas of the lower lobe bronchi do not respond well to the usual thoracoplasties Here, only revision and resuturing of the bronchial stump is indicated Thoracoplasty alone is not successful in fistulas of the main bronchus Therefore, the authors combined an extensive thoracoplasty with revision and resuturing of the bronchial stump The above-described mobilization of the aorta was used

Of 237 patients who had resection for tuberculosis, postoperative fistulas developed in 22 (9 3%) Of these, 14 had 21 operations, according to the approaches and indications mentioned There were 5 deaths and 7 cures, 2 patients were under treatment for recurrent fistulas at the time of follow-up

Some Physiologic Changes Associated with Surgical Excision of Emphysematous Bullae are discussed by Martin J FitzPatrick, C Frederick Kittle, T K Lin and James C Dowell[1] (Univ of Kansas) A bulla, typically seen in patients with pulmonary emphysema, is thought to result from rupture of a dilated alveolus into adjoining alveoli, thus forming a larger space or air sac, anatomically connected to the bronchial tree The bulla differs from a bleb, which is caused by the rupture of an alveolus into interstitial tissue with resultant dissection of the visceral pleura from underlying alveoli

Ten patients with large bullae and pulmonary emphysema were treated by surgical excision of the bullae One patient died postoperatively The benefits from this therapy were most marked in patients with the greatest cardiopulmonary

(1) Am J Med 22 534-548 April 1957

disability, and readily apparent in the restoration of abnormal cardiovascular dynamics to a more normal range

After excision of bullae, 4 hypoxic patients showed a lower pulmonary artery pressure They had severe, long-standing pulmonary emphysema with crippling of effective ventilation During the gradual development of giant bullae in these patients, the surrounding lung areas are often compressed This accentuates the abnormal alveolar ventilation-perfusion relationships commonly seen in advanced emphysema, and augments hypoxia and hypercapnia through a series of physiologic right-to-left shunts The delicate intrapulmonary control mechanisms responsible for blood-gas homeostasis may become ineffective under these circumstances, and perfusing blood is no longer directed away from inadequately ventilated lobules The partial relief of this distorted state through surgical decompression of poorly ventilated, but still perfused segments tends to reduce hypoxia Thus, a lower pulmonary artery pressure and vascular resistance follows along with restoration of a more normal cardiac output Another factor possibly contributing to reduction in pulmonary arterial pressure may be expansion of the pulmonary vascular bed secondary to decompression of the cysts

The possibility that surgical removal of giant bullae might delay the development of cardiopulmonary failure at some future date in patients with progressive pulmonary emphysema cannot be excluded However, it would appear that nonsurgical therapy offers more promise for relief of symptoms in these patients

► [These studies indicate that complicated or highly symptomatic bullae should be removed The problem which remains to be solved concerns the advisability of surgical treatment for patients with relatively large but uncomplicated and essentially asymptomatic bullae There is need for a long term study of such patients in order to determine the natural course of this disease —Ed]

Surgical Treatment of Emphysematous Blebs is discussed by Brian Blades and Owen Gwathmey[2] (George Washington Univ) based on their experience with 82 patients Surgical treatment of spontaneous pneumothorax resulting from rupture of subpleural blebs has been highly successful In many patients the initial attack of pneumothorax is followed by re expansion of the lung with no recurrence Pleural ad

(2) M Ann District of Columbia 26 119 124 March 1957

hesions from the pneumothorax, *particularly if needle aspirations* or tube drainage has been performed, result in a protective pleural symphysis.

In cases requiring an open operation, results have been excellent. Excision of the bleb or blebs combined with production of pleural adhesions has resulted in protection from subsequent attacks. In this series and earlier experiences, there are no known recurrences. Early fears that the production of pleural adhesions would cause serious reduction of pulmonary function are not substantiated.

If there are localized emphysematous changes in the lung adjacent to the blebs, it is usually desirable to excise the involved lung tissue. The amount to be removed can be determined only after the lesion is seen. Conservation of functioning lung tissue is essential. Total lobectomy should be avoided.

In patients who have giant blebs with generalized emphysema, *excision or obliteration of the large space-*occupying bleb allows expansion of remaining functioning lung tissue In addition to the reduction of tidal air for mechanical reasons, increased CO_2 concentration in the bleb is probably distributed to adjacent lung tissue by air drift between pulmonary lobes and segments. Many patients with emphysema complicated by large pulmonary blebs can be greatly improved by surgery.

► [Our experience confirms these observations and supports the conclusion that patients with emphysema complicated by large pulmonary blebs can be improved greatly by surgical therapy.—Ed.]

Arteriovenous Fistulas and Arterial Aneurysms of Pulmonary Arterial Tree. Rodman E. Taber and J. L. Ehrenhaft[3] (State Univ. of Iowa) conclude that pulmonary arteriovenous fistulas may cause cyanosis, finger and toe clubbing, polycythemia, and occasionally a continuous bruit audible over the chest wall in the region of the lesion. Cardiac enlargement seldom occurs The Valsalva and Müller maneuvers during cardiac fluoroscopy should demonstrate a change in the size of the radiologic density with changing intrathoracic pressures Angiocardiography is the most valuable diagnostic procedure The size, configuration and multiplicity of the lesions can be shown The condition is often bilateral Pulmonary function studies and cardiac catheteri-

(3) A.M.A. Arch. Surg. 73:567-577, October, 1956

zation demonstrate the presence of a right-to-left pulmonary vascular shunt Systemic arterial blood shows persistent oxygen desaturation despite breathing of 100% oxygen Cardiac catheterization shows that the right ventricular and systolic pulmonary artery pressures are normal whereas the pulmonary artery pulse pressure is increased because of a lowered diastolic pressure

The preferred treatment is surgical excision Two patients with pulmonary arteriovenous fistulas were treated surgically and 1 died The surgical and autopsy specimens were studied by a plastic bronchovascular cast injection and the results support the hypothesis that the fistulas are caused by persistent developmental arteriovenous communications

Patients with true pulmonary artery aneurysms do not show signs of peripheral arterial desaturation, finger and toe clubbing, or polycythemia They do show signs of right sided hypertrophy Harsh systolic murmurs may be audible over the aneurysms Cardiopulmonary fluoroscopy reveals expansile pulsations of the lesions Intravenous angiocardiography demonstrates opacification of the aneurysm One patient with bilateral pulmonary artery aneurysms was treated successfully by bilateral resections Cardiac catheterization showed elevated right ventricular and pulmonary artery pressures

Paulino Thoracoplasty was performed by William J McLaren[4] (Tranquille, B C) on 35 patients

TECHNIC —The operation consists of removal of the 2d, 3d and 4th ribs in decreasing lengths from above downward, followed by complete apicolysis The liberated apex of the lung containing the disease is then constricted by a series (usually 3) of purse-string sutures placed round it from above downward The apex is held in a curved clamp during insertion of the sutures of no 4 black silk or no 10 crochet cotton It is essential that the sutures pass through both parietal and visceral pleura to prevent the lung from slipping downward should a free pleural space exist The extraperiosteal pneumolysis is carried to below the level of the diseased area, this may be to the level of the hilus on the mediastinal aspect and as low as the 7th interspace posterolaterally Where the disease extends downward, possibly into the superior segment of the lower lobe, the posterior half of the 5th rib is also removed

The author favors the Paulino thoracoplasty because it fulfills most completely the requirements of the ideal collapse

(4) Dis Chest 30 513 522 November 1956

operation. This 1 stage, safe operation in which no foreign material is introduced, is applicable to cases of far-advanced and bilateral tuberculosis. The procedure causes minimal deformity, leaves the scapula outside the ribs and secures maximal function.

Almost all patients had streptomycin and paraaminosalicylic acid, with or without isoniazid, for at least 5 months preoperatively. Thus, many were already sputum negative on direct smear. In nearly all, antibiotics were discontinued 2 months postoperatively. After 6 months' follow-up, 31 patients were well with sputum negative on culture; 3 had positive sputum and 1 had died

Surgical Treatment of Lower Lobe Tuberculosis. Viking Olov Bjork[5] (Stockholm) observes that after a lower lobe

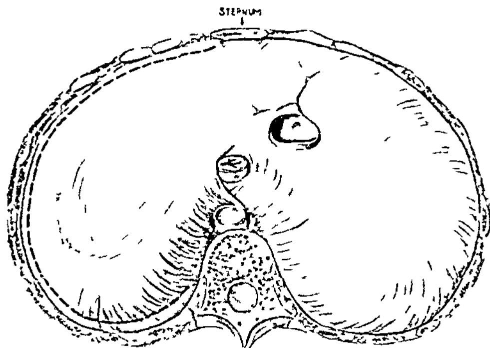


Fig 11 —Diaphragm is incised in periphery down to peritoneum. (Courtesy of Bjork, V O J Thoracic Surg 31 655 671 June, 1956)

resection the thorax must be diminished (1) when a segment or more from the middle or upper lobe has to be resected at the same time as the lower lobe lobectomy, (2) if palpable tuberculosis is found in the remaining portion of

(5) J Thoracic Surg 31 655 671, June, 1956

the lung, (3) if an empyema is resected at the same time, (4) when the tuberculous cavity is opened during the operation, (5) if the other lung is markedly emphysematous or fibrotic and (6) if there is significant contralateral tuberculosis.

The space can be diminished from below by basal thoraco-



Fig 12 —Diaphragm is dissected from peritoneum to centrum tendineum (Courtesy of Bjork, O V J Thoracic Surg 31 655 671, June, 1956)

plasty, elevation of the diaphragm by phrenic crush or mobilization and resuturing at a higher level. It can be diminished from above by apical extrapleural plombage, primary apical thoracoplasty with lower lobe lobectomy at a second stage or single stage lower lobe resection and upper osteoplastic thoracoplasty.

In lower lobe resections where the other lung parenchyma

is healthy, the chest may be left intact. The resulting over-expansion increases minute ventilation and thus the respiratory work for the same oxygen uptake on the side on which the operation was performed. A primary basal thoracoplasty gives a good functional result, but severe deformity results. Diminishing the thoracic cavity from above, displacing the

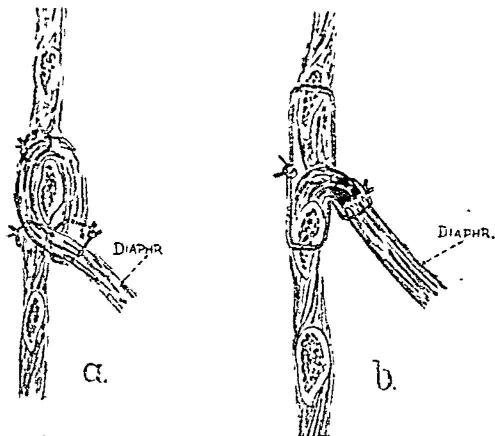


Fig 13.—Diaphragm is resutured, *a*, around a rib, *b*, to an intercostal muscle. (Courtesy of Bjork, V O J Thoracic Surg 31 655 671, June, 1956)

upper lobe downward to the diaphragm, usually gives a good functional result. A poor result follows use of apical extra-pleural plombage, but a plastic plombage placed above a healthy lobe has given good results. An excellent functional result follows the 1-stage lower lobe resection with osteo-plastic thoracoplasty. Elevation of the diaphragm will, however, give as good or even better results, but has so far only been used in a few clean cases.

TECHNIC —To elevate the diaphragm by mobilization and resuturing at a higher level an incision is made as peripherally as possible in the diaphragm (Fig 11) Separation of the diaphragm from the peritoneum is easily performed in the periphery and can be carried in to the centrum tendineum (Fig 12) Mobilization of the diaphragm is best started posteriorly where there is no danger of opening the peritoneum The diaphragm is then resutured This may be done as in Figure 13 *a* where it encircles the 6th rib and is sutured to itself and to the intercostal muscles or after subcostal incision under the 5th rib the diaphragm may be sutured to the 5th intercostal muscle bundle by a row of fine interrupted silk sutures (Fig 13 *b*) The latter method is preferable Posteriorly the diaphragm is resutured to muscles in the intercostal spaces with heavy Nylon sutures tied around the posterior ends of the ribs With intact nerve supply the resutured diaphragm acts normally postoperatively although its excursions are small

Resection in Pulmonary Tuberculosis Results and Follow up of 700 Cases J J Hirdes and C I Stegerhoek[6] (Bilthoven The Netherlands) report 700 patients who had lung resection Neither extremely young nor aged patients were excluded from surgery Mortality was 3 3% There were 9 tuberculous and 4 nonspecific empyemas Incidence of relapse in a follow up of 2 5 years was 7%

Results of lung resection for tuberculosis depend on the nature and activity of the tuberculous process extent of the resection degree of sensitivity of the tubercle bacilli to antibiotics and age of the patient In general resection and collapse therapy in its different forms have their own indications Of the study patients 6 1% had a destroyed lung with or without tuberculous empyema with bronchopleural fistula As a rule these patients cannot be saved except by radical resection *Despite the risk results are better* than those of thoracoplasty which cannot arrest such extensive and active tuberculous processes The same applies to patients with bronchostenosis from tuberculous bronchitis (3 7%) For extensive bilateral cavernous processes which do not react to bed rest and antibiotics collapse is the only therapy However for localized unilateral cavities with slight activity the authors prefer resection when active treatment is essential When resection is not used as a last resort when all other treatment has failed but is chosen for its own indications (tuberculous pr cesses of restricted extent and relatively slight activity) its results are best

(6) Dis Chest 30 77 288 September 1956

Pneumonectomy for Pulmonary Tuberculosis: Analysis of 151 Cases. Many patients undergoing pneumonectomy for pulmonary tuberculosis are in bad condition. They may be toxic, having had fever, with considerable expectoration, for several months. The respiratory reserve usually is small because of disease of the only functioning lung or residues after a previous pneumothorax. Pneumonectomy is reserved for destroyed lungs whether a bronchial stenosis is present or not. Viking Olov Björk[7] (Stockholm) recommends a 1-stage procedure with resection and osteoplastic wall thoracoplasty. If function of the remaining lung is impaired by disease or an old pneumothorax, the respiratory work for the patient in the postoperative period is often too great, with carbon dioxide retention resulting. Then, prolonged artificial ventilation through a tracheostomy is indicated until the patient regains strength enough to perform adequate ventilation and bring up the secretion.

Björk performed pneumonectomy on 66 males and 85 females, aged 11-64. Treatment methods were gradually changed from a several-stage procedure in which first thoracoplasty preceded resection, to a 1-stage operation with an osteoplastic wall thoracoplasty. In 49 patients, a curative thoracoplasty was first performed in 2, 3 or 4 stages. In 1-10 years, pneumonectomy was performed after thoracoplasty had failed. In 47 patients, a first-stage 5-rib (or 3-rib) thoracoplasty with apicolysis was performed. After some months, pneumonectomy was performed and rib resection was extended to include the 9th rib on the left side and the 10th rib on the right. This method is now abandoned in favor of the 1-stage procedure. In 17 patients, pneumonectomy was performed as the first operation and total thoracoplasty later —in 1 stage in 12 patients and in 2 stages in 5. Total thoracoplasty, sometime after pneumonectomy, is well tolerated and usually need not be divided into 2 stages.

To achieve a 1-stage procedure, a plastic plombe (Polystan) was introduced intrapleurally in 7 instances and extraperiosteally in 5, after completion of pneumonectomy. Only patients were chosen in whom there was considered to be no danger of infection. Follow-up after a year showed no untoward effects from the plombe. In 4 patients, total

(7) J. Thoracic Surg 32 528-547, October, 1956.



Fig 14 Mediastinum is kept in midline 1 year after osteoplastic wall thoracoplasty (Courtesy of Bjork V O J Thoracic Surg 32 528 547 October 1956)

thoracoplasty with rib resection was performed at the same stage as pneumonectomy Only patients in good condition were chosen

To prevent paradoxical movement of the mediastinum in the postoperative period and to prevent a later mediastinal shift to the side operated on an osteoplastic wall thoracoplasty was worked out and used in 21 patients With this method a 1 stage procedure can be applied to patients with limited respiratory function and with tuberculous empyema

In 13 patients in this group, extrapleural pneumonectomy had to be performed There was one complication with infection Postoperatively, 5 of these patients needed prolonged artificial ventilation through a tracheostomy The method

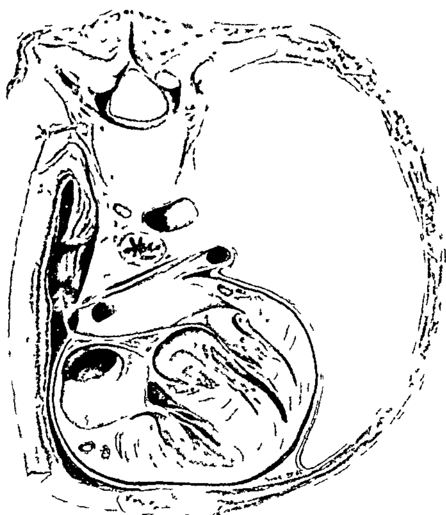


Fig 15 —Posterior ends of ribs bent or fractured in costal cartilages are fixed to vertebral bodies through costovertebral ligament behind rib by Nylon threads (Courtesy of Bjork V O J Thoracic Surg 32 528 547 October 1956)

includes most often resection of the 1st rib and posterior parts of the 2d and 9th ribs on the left side and 2d to 10th ribs on the right The posterior ends of the ribs, bent or fractured in the costal cartilages, are then fixed to the vertebral bodies through the costovertebral ligament by Nylon threads



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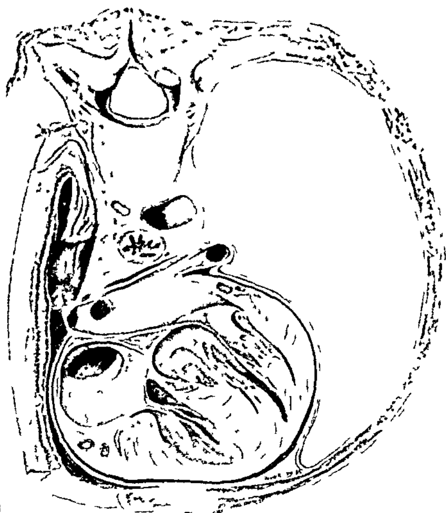


Fig. 15.—Posterior ends of ribs bent or fractured in costal cartilages are fixed to vertebral bodies through costovertebral ligament behind rib by Nylon threads. (Courtesy of Björk, V. O.: J. Thoracic Surg. 32:528-547, October, 1956.)

includes most often resection of the 1st rib and posterior parts of the 2d and 9th ribs on the left side and 2d to 10th ribs on the right. The posterior ends of the ribs, bent or fractured in the costal cartilages, are then fixed to the vertebral bodies through the costovertebral ligament by Nylon threads

through drill holes in the posterior ends of the ribs Thus, the mediastinum is kept in the midline for the future (Figs 14 and 15)

Of 111 patients followed 1-5 years after operation, 97 (87%) are considered "cured" Of the 14 with recurrence, 5 are well and working with negative sputum but have positive guinea pig tests for gastric washings

► [These are highly commendable results and reflect the meticulous care given to this pulmonary problem by Swedish surgeons —Ed]

Pulmonary Resection for Tuberculosis 5- to 10 Year Follow-up Study James D Murphy (Baltimore) and James M Davis[8] (VA Hosp, Oteen N C) report on 148 patients with 150 pulmonary resections during 1946 50, immediately after introduction of streptomycin, 83 were pneumonectomies and 67 lobectomies or resections of smaller units Two patients had a second resection The patients were aged 20 56, 52 were Negroes 36 (69%) of whom had pneumonectomies Streptomycin was given during the pre- or postoperative periods, or both, in 97% of the patients, 101 of whom had original treatment and 45 retreatment Judged by present standards of chemotherapy the duration of streptomycin treatment was inadequate The disease was far advanced in 85% of those who had pneumonectomy and 58% of those with lobectomy Positive sputum was found in 91% immediately after operation Positive smears or cultures were obtained in 40 (27%) during postoperative hospitalization The conversion rate was higher in pneumonectomies (77%) than in lobectomies (67%), and preoperative thoracoplasty in the latter group apparently did not influence sputum conversion Open lesions were present in 85% of the entire group and all but 9 were sputum positive

The commonest indication for lung resection was thoracoplasty failure followed by destroyed lung and pneumothorax failure Thoracoplasty was done in 41% preoperatively and 42% postoperatively No concomitant thoracoplasties were done

Bronchopleural fistula occurred after 15% of subtotal resections and 26% of pneumonectomies, many patients were salvaged, and at final follow up 44% were at home with in

(8) J Thoracic Surg 32 7 2 775 December 1956

active disease Complications occurred in 46% of the entire group, with a higher incidence in white patients

Eighteen patients died in the hospital and 8 after discharge; thus the surgical mortality was 9% and total mortality 17%. The death rate was higher for pneumonectomies, 3 of the 4 operative deaths were due directly to hemorrhage and one to cardiac arrest which occurred in the early stage of a secondary resection The 14 postoperative deaths were due mainly to bronchopleural fistula or sequelae, pneumonitis, spread, cerebrovascular accident, tuberculous meningitis, etc The 8 nonsurgical deaths resulted from malignancies, heart disease, diabetes, accidents and other causes not related to the surgery

Of the original 148 patients, 107 (72%) had a good or satisfactory result There was no significant racial difference in those with satisfactory results Late reactivation occurred in 25 (17%) of the patients, 12 recovered, 7 on medical therapy and 5 after secondary resections Eleven treated medically remain alive, 1 died of his disease and another after a second resection

Solitary Pulmonary Nodule: 10-Year Study Based on 215 Cases. Edgar W Davis, J. Winthrop Peabody, Jr and Sol Katz[9] (Georgetown Univ) define the solitary pulmonary nodule as a round or ovoid, circumscribed and smooth solitary mass, 6 cm or less in diameter, lying within the pulmonary parenchyma without any demonstrable calcium or cavitation within the nodule and associated with no or minimum pneumonitis, atelectasis or regional lymphadenopathy Of 215 nodules treated by surgery, 47% were malignant and 53% benign The malignant group included 79 bronchogenic carcinomas, 9 bronchial adenomas 1 fibrosarcoma, 1 leiomyosarcoma, 1 lymphoblastoma and 10 metastatic tumors The benign group included 82 granulomas, 9 hamartomas, 6 pleural mesotheliomas, 4 chronic pneumonitis, 3 bronchogenic cysts, 3 bronchopneumonia sequestrations, 2 neurofibromas, 2 chronic lung abscesses, 1 lipoid granuloma, 1 hyperplastic lymph node and 1 "aspergilloma" The malignant ratio in different age groups is shown (Fig 16) Malignant lesions were not uncommon in the younger patients In the entire

(9) J Thoracic Surg 32 728 770 December 1956

group only 37 6% were women The lobar distribution of the nodules was fairly even, with no great difference between malignant and benign tumors Although most patients had no symptoms, there was a higher incidence of cough, hemoptysis and severe arthralgia involving one or more joints, with clubbing of the digits in those with carcinoma

It is impossible to distinguish benign and malignant lesions

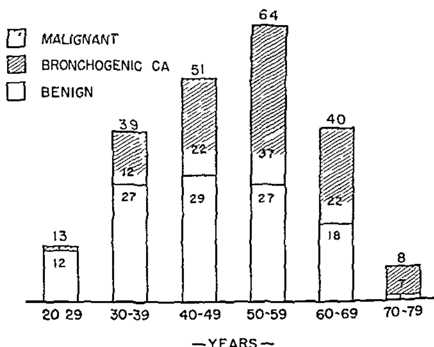


Fig 16—Percentage of malignant nodules among different age groups In older patients ratio was over 50% but even from ages 30 to 39 almost 1 nodule in 3 was malignant a forceful argument against those who contend that chance of malignancy *is remote in persons under 40* (*Courtesy of Davis E W et al* J Thoracic Surg 32 728 770 December, 1956)

by any means other than thoracotomy Analysis of clinical, laboratory and x ray data has not yielded any sign reliable enough to justify medical observation unless it be calcification within the nodule The members of the American Association for Thoracic Surgery were polled on the reliability of calcification as an indication of benignity The results indicated that minimum calcification within a solitary pulmonary nodule, especially when no more than a fleck or two, is unjustifiable grounds for assuming it to be benign There remain certain patterns of calcification that render the pos-

sibility of malignancy so slim, however, that further observation seems warranted These include those nodules with a large central calcific core and diffuse calcific stippling, those with an inner ring or outer rim of calcium and those that are completely calcified

All but 8 patients had their lesions resected There were no deaths following thoracotomy with limited resection The mortality rate for the entire group was 2 8% The morbidity rate was correspondingly low The study indicates the safety in exploring every patient with a solitary, noncalcified pulmonary nodule

Of the 79 bronchial carcinomas, 36 (including 9 bronchiolar carcinomas) were adenocarcinomas, 34 squamous carcinomas and 9 undifferentiated carcinomas All had the same prognosis, except the bronchiolar carcinomas, which had a poor prognosis Potential "cures" were obtained in 36 patients (45 6%), including 17 3-year survivors, 10 2-year survivors, and 9 who survived less than 2 years The survival was longest in those who had no symptoms or lymph node metastases who were observed for short periods preoperatively The patient with a small, solitary, circumscribed, asymptomatic bronchial carcinoma recently detected in a fortuitous chest x-ray has a 75% chance of surviving 5 years if operated on promptly Lobectomy is a sound procedure and adequate for cancers presenting as a well-circumscribed lesion, peripherally situated and free of gross lymph node involvement

Bronchial adenomas must be classified as malignant lesions They often occur peripherally A *solitary pulmonary* nodule should be explored in patients with carcinoma elsewhere, since not all the chest lesions will be metastatic nodes Of the 82 granulomas, 71 were studied by special stain, 12 were tuberculomas, 39 histoplasmonas, 1 a histoplasmic lymph node, 5 coccidiomas and 14 were classified as nonspecific

►[This study adds further evidence of the importance of diagnostic thoracotomy in the management of solitary pulmonary nodules as defined by these authors —Ed]

Mass Survey Detected Lung Cancer in Connecticut, 1949-1953, revealed 9 2/100,000 x rays, according to Richard A

Greenberg[1] (Connecticut State Dept of Health) Of 10,345 positive chest x-rays, 729 representing 716 persons were considered tumor suspects, but 257 were immediately eliminated Of the other 459, 71 were found in the Cancer Record Register and 86 could not be traced further No medical diagnosis was made in 169, 63 were unknown to the doctor listed as family physician, and of the other 106, 94 remained undiagnosed while under medical supervision

Seventy six persons were discovered with malignant tumor, definite thoracic abnormalities were seen in 56 of these, 33 from primary lung malignancies and 23 from metastases Each of the remaining 20 had primary malignancy in a site other than the chest 3 had benign chest lesions and 17 chest lesions of unknown character

Of the 33 primary lung cancers detected, 31, or 93 9%, were discovered by mass x ray screening before being reported to the Cancer Record Register This is statistically significant and proves the potential value of the mass x ray screening technic as an early diagnostic aid in detecting lung cancer The necessity for more efficient follow-up is shown both through tumor suspect cases undiagnosed (23 6%) and delay between x ray and diagnosis among confirmed malignancies (only 36 4% were diagnosed within 1 month) Without these, much of any potential advantage of a mass screening technic is lost

Mass surveys for detecting tuberculosis include only a small percentage of men over 45 Mass x-ray surveys for detecting lung cancer do not offer any great hope for the ultimate cure of patients with pulmonary cancer Nevertheless, this is currently the most efficient technic available for detecting lung cancer

Increase in Lung Cancer in Massachusetts is discussed by Herbert L Lombard[2] (Massachusetts Dept Pub Health, Boston), who found that during 1900 25, there was no statistical difference between male and female death rates for cancer of the lung and only a slight increase in total incidence of the disease During 1925 30, death rates for both sexes increased, with an indication that the rates were separating

(1) Connecticut M J 20 857 863 November 1956
(2) Cancer 9 667 670 July Aug 1956

From 1931 to 1953, there were significant differences between male and female death rates This trend is consistent with the hypothesis that cigaret smoking is a cause of cancer of the lung

There are a number of variables that show increases similar to that of cigaret consumption, but few of these have a sex differential Increase in registered automobiles has been greater than the increase in consumption of cigarets It has been assumed there would be no sex differential for a large part of the population with respect to exposure to automobile fumes, but garage mechanics, traffic patrolmen, streetworkers, truck and taxi drivers and others in occupations requiring constant use of automobiles in traffic are more greatly exposed The author reviewed 500 lung cancer records to determine the number of patients who had worked in such occupations for more than 10 years He found that 15% of patients with lung cancer had had these occupations Another 8 6% had had occupations that might have exposed them to an unusual amount of exhaust fumes It might be considered that the total of 23 6% is the maximum for these two groups However, 84 3% of those with lung cancer had smoked the equivalent of one pack of cigarets a day for 20 years, indicating that cigaret smoking is much more closely associated with lung cancer than are automobile exhaust fumes

Environmental Causes of Cancer of Lung Other Than Tobacco Smoke are discussed by W C Hueper[3] (Natl Inst of Health) With one exception, all known exogenous respiratory carcinogens were discovered during the last 25 years (table), a period in which a remarkable and progressive rise in the number and frequency of lung cancers was observed in most industrial countries The various respiratory carcinogens are fairly well-defined chemical or physical agents and/or are associated with distinct occupations engaged in by circumscribed worker groups Clinical, epidemiologic, pathologic and experimental observations related to these agents, which act through the respiratory route, represent the only reliable evidence available on the cause of cancers in different parts of the respiratory tract Despite the

(3) Dis Chest 30 141 159 August 1956

relatively small total number of occupational pulmonary c: cers on record, the comparatively high cancer rates amc the different worker groups studied provide weighty e dence for causal relations between exposure to spec agents and subsequent development of respiratory cancers

Some lung cancers were certainly mistaken for tubercu sis, pulmonary abscesses, silicosis, asbestosis, siderosis other chronic pulmonary diseases The almost exclusive currence of occupational lung cancers in male work agrees with the fact that they predominate in occupati

OCCUPATIONAL RESPIRATORY CARCINOGENS AND CANCERS RECORDED DURING PAST 75 YEARS

Agent	Site	Discovered	No Recorded Cases U S A	Other Countries	Tot:
Arsenic	Lung	1930	7	16	2
Asbestos	Lung	1934	20	92	11
Chromates	Lung	1932	75	65	14
Nickel	Lung	1932	0	84	8
	Nares				
	Nasal sinus		0	51	5
Coal tar	Lung	1936	0	53	5
Petroleum	Lung				
oils	Larynx	1936	7	33	4
Isopropyl oil	Lung	1946	1	0	
	Larynx		4	0	
	Nasal sinus		6	0	
Radioactive	Lung	1879	0	625	62
Chemicals	Nasal sinus	1931	3	0	
Total			123	1 019	1 14

having lung cancer hazards An exception is the lung canc in female asbestos workers

Several types of industrial lung cancers, such as th caused by radioactive substances, chrome pigments and c tar fumes show a shift into age groups younger than th in which cancers of the lung of cryptogenic origin are served, but characteristic of occupational cancers Occu tional respiratory cancers have long latent periods like ot cancers of known industrial or environmental origin T relatively massive exposure to carcinogens often present occupational conditions may explain the occasional mu centric genesis of several types of occupational lung canc

i e , asbestosis cancer and radioactive cancer. Many occupational respiratory carcinogens, such as arsenicals, radioactive substances, coal tar and petroleum oils, were previously known as important causes of occupational and medicinal skin cancers usually developing on cutaneous exposure.

The demonstration of recognized environmental respiratory carcinogens in the atmosphere, especially of cities, and of consistently and markedly higher lung cancer death rates for urban over rural populations, strongly suggests that industry-related air pollutants may be a causative factor in lung cancer and its recent considerable increase in most industrial countries However, occupational and industry-related carcinogenic air pollutants are not the only factors responsible for pulmonary carcinogenesis

Carcinoma of Lung: Epidemiology, Clinical Features and Treatment. O Peräsalo, E Laustela and T. M Scheinin[4] (Helsinki) studied 716 patients, 682 (95 2%) men, with pulmonary carcinoma Diagnosis was pathologically confirmed in 516 (71 1%) Histologically, the largest group was that of epidermoid carcinoma This type was relatively more common in urban than in rural patients Operability appeared to be better in urban than rural patients This seemed due to the difference in distribution of the types of carcinoma The epidermoid type proved suitable for resection

Only 1% of patients were hospitalized during the silent phase of the disease They were detected mainly through x ray screening procedures Secondary inflammatory changes accompanying pulmonary cancer were detected in more than three fourths of examined specimens Findings ranged from small bronchopneumonitic foci to pneumonia involving almost the whole lung and to pulmonary abscess Bronchoscopy with biopsy led to correct diagnosis in about 50% In 12 9%, diagnosis was made at exploratory thoracotomy

Of the cases, 56 4% were inoperable The commonest reasons for inoperability were extensive growth of the tumor or its too central location Thoracotomy was performed in 283 (39 5%), this remained exploratory in 89 The tumor was removed in 194 (27 1%) Mainly because of lymph node me-

(4) Acta chir scandinav 111 257 273 1956

tastases, operation was only palliative in 55 In 139 (19 4%) resection was radical The tumor was removed in 68 5% of patients subjected to thoracotomy The most common operative complications were disturbances in peripheral or central circulation and thromboembolism Together these constituted three fourths of all postoperative complications and caused 90% of fatalities

Investigation into Lymphatic and Vascular Spread of Carcinoma of Bronchus H C Nohl[5] (London Chest Hosp) dissected 100 specimens of lungs, resected for bronchogenic carcinoma, to determine the site and extent of growth and vascular and lymphatic involvement Incidence of lymph node involvement was 75% A constant lobar lymphatic drainage was found

A comparison of lymphatic invasion rates between different lobes showed that tumors of the lower lobes on each side have a greater tendency to metastasize than those of the upper lobes and that if the tumor transgresses the fissure the invasion rates rises significantly

Of the squamous carcinomas, 37 2% showed either no lymphatic involvement or only infiltration of the intrapulmonary nodes as compared with 17% of the undifferentiated carcinomas Mediastinal lymph node involvement of the two types was 34% as compared with 60 7%, and vascular involvement, 23 7% as compared with 40% (squamous to undifferentiated carcinomas) There was no significant difference between histologic types with regard to extent of growth The peripheral tumors behaved in the same way as the central tumors with respect to extent of growth and lymph node involvement Squamous cell carcinomas were more often centrally than peripherally located (66% compared with 34%) Most adenocarcinomas were found in the periphery

Treatment of Lung Cancer Indications and Results Hans Rahbek Sørensen and Frederik Therkelsen[6] (Rigshosp , Copenhagen) reviewed results of surgery and operative indications in 732 patients with lung cancer Though the operability rate increased even among recent hospitalizations only half the patients had had symptoms less than 6 months Op

(5) Thorax 11 1 2 185 September 1956
(6) Acta chir scand nav 111 239 250 1956

erative mortality was rather high, one third of deaths following pneumonectomy or lobectomy were due to embolism of the pulmonary artery Mortality of pneumonectomy was about twice that of lobectomy Mortality increased greatly with age

There were 176 patients followed more than 1 year after pneumonectomy or lobectomy and 73 more than 5 years, 26 are alive In patients with undifferentiated carcinomas, with mediastinal and hilar node involvement and over age 70 prognosis was poor.

Early diagnosis is the most important factor in treatment If patients are seen at an early stage, there is a chance not only of a higher operability rate but also of performing more lobectomies thus lowering operative mortality and disability after operation

Indications for Lobectomy in Treatment of Carcinoma of Lung Joseph L Robinson, John C Jones and B W Meyer[7] (Los Angeles) conducted a survey among the surgeons in the American Association for Thoracic Surgery to determine to what extent and under what conditions they use lobectomy in patients with lung carcinoma Of 318 members replying, 91 8% use lobectomy in metastatic pulmonary carcinoma 92 8% in primary pulmonary carcinoma and about 60% as an operation of choice in primary lung carcinoma, about 57% believe lobectomy offers as good a chance for long-term survival as does pneumonectomy

The authors treated 123 patients by pneumonectomy and 21 by lobectomy The 3 year survival in the 123 patients was 16 3%, in the 21 patients, 71 4%

Based on the replies, as well as on their own experience, the authors suggest a guide for selecting patients with primary lung carcinoma to be treated by lobectomy (1) Lobectomy is the operation of choice when the patient has a peripheral lesion located well away from the fissures or adjacent lobes, with a satisfactory proximal length of uninvolved bronchus and with no apparent extension to adjacent tissues nor to the peribronchial, hilar or mediastinal lymph nodes (2) It is used as a compromise operation when the lesion does not satisfy these conditions, but cardiorespiratory or

(7) J Thoracic Surg 32 500 507 October 1956

other clinical condition makes the patient unsatisfactory for total pneumonectomy (3) Lobectomy is used as a palliative procedure when a lesion is found at operation which cannot be completely eradicated surgically, but clinical appraisal has indicated that such symptoms as hemoptysis, cough or infection can be controlled better by lobectomy than by non surgical means

► [The indications for lobectomy listed by these authors are generally accepted, and under these circumstances the survival rate is probably not much different from that following pneumonectomy —Ed]

Pulmonary Resections for Metastatic Lesions to Lung were performed by Joseph W Gale and James W Brooks[8] (Univ of Wisconsin) in 14 patients, observing the following indications (1) Unilateral evidence of pulmonary involvement—this ideally should include only a solitary lesion However, several lesions in a single lobe or single lung are still candidates for resectional metastatic pulmonary surgery provided the opposite lung shows no metastatic disease (2) Reasonable assurance that the primary malignancy has been eradicated (3) No evidence of metastatic involvement of any other organ (4) A long time between discovery and eradication of the primary lesion before appearance of pulmonary metastases (though in cases reported in the literature, a long period between primary and metastatic lesions does not imply a better final prognosis) (5) Suppuration and abscess formation in a metastatic focus due to bronchial obstruction Lobectomy was performed in 10 patients and pneumonectomy in 4 The survival times were 3 82 months The results of such treatment leave much to be desired but compared to those obtained after resection for carcinoma of the stomach and gallbladder and for primary bronchogenic carcinoma, there is little difference in the percentage of salvaged patients

Results of Raising Resectability Rate in Operations for Lung Carcinoma Surgical removal offers at present the only hope for cure of carcinoma of the lung and is the best palliative procedure available Exploration alone is of little palliative value Because of these considerations, R Abbey Smith[9] (Warwick, England) removed as much of the lesion as pos

(8) Wisconsin M J 56 140 145 March 1957
(9) Thorax 12 79 86 March 1957

sible in each patient in whom the lesion was explored by thoracotomy. Patients with clearly inoperable lesions were not subjected to thoracotomy.

Of 147 consecutive patients with lung carcinoma operated on, the growth was removed by pneumonectomy or lobectomy in 143, a resectability rate of 97.2%. Two thirds of these procedures were considered curative and one-third palliative. The operation was considered palliative if obvious and unmistakable tumor tissue was present in the great vessels, lymph nodes, bronchi or the chest wall which could not be removed.

Of the 48 patients who had palliative surgery, 10 died in the hospital. Of 95 who had curative surgery, 8 died in the hospital. In the palliative group, 36 of the 38 survivors left the hospital before the 16th postoperative day. Palliation was considered worth while if the patient lived at least 8 months and returned to work, criteria which were fulfilled by half the survivors.

Patients cannot be divided into curative and palliative groups before surgery. The mortality rate of 20% for palliative resection is high. However, this is not the mortality rate of an operation undertaken for incurable cancer, but the results to be expected from resection when the local extent of the growth is manifest at operation. Compared to results of closure of the chest without attempts at resection, this figure seems less excessive.

The 19 patients in whom good surgical results were not obtained died within 1 year of surgery; all had metastases. None developed symptoms directly referable to operation, such as gross respiratory insufficiency or the sequelae of infection in the pneumonectomy space. Hemoptysis and excessive sputum were relieved, but no conclusion could be reached regarding relief of pain. The failure to relieve or prevent pain was the most disappointing feature of palliative resection. The length of the final illness appeared significantly reduced in patients who had palliative resection.

The difference in results between the various methods of treating lung carcinoma which has advanced to the stage of involvement of the mediastinal structures is not great. While thoracotomy remains the only certain method of determining

operability and resection the only known cure, palliative resection seems indicated wherever possible

► [The operative mortality associated with resection of carcinoma when the lesion has produced gross invasion of surrounding structures is so high that the procedure can scarcely be called palliative In addition to the immediate mortality, the incidence of nonfatal complications is high, and the discomfort and morbidity of the operation is often as disabling as the primary disease, considering the fact that life expectancy is so short Irradiation therapy will often relieve symptoms as well as resection with much less morbidity —Ed]

Factors which Influence Long-Term Survival of Patients with Cancer of Lung were evaluated by John H Gibbon Jr, John Y Templeton, III, and Thomas F Nelson, Jr[1]

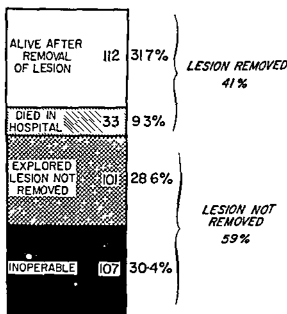


Fig 17 —Disposition of 353 cases of cancer of lung (Courtesy of Gibbon J H Jr *et al* Ann Surg 145 637 641, May, 1957)

(Jefferson Med College), in 353 patients seen from April 1946 to January 1951 As Figure 17 shows, 107 (30%) had inoperable lesions Of 246 patients (70%) operated on, cancer was removed in 145—59% of those explored and 41% of the entire series, 136 pneumonectomies, 8 lobectomies or bilobectomies and 1 local excision were performed Operative mortality was 23%

Of 208 patients whose cancers were not removed, 4 lived over 5 years Histologic diagnoses were based on neoplastic

(1) Ann Surg 145 637 641 May 1957

cells in bronchial secretions One patient died 5½ years after first examination; 1 was alive 6 years and 2, 8 years after. Of 145 patients whose cancers were removed, 30 (21%) survived 5 years (27% of 112 patients who survived operation) Pneumonectomies were performed in 28 of these survivors. The pericardium was opened in only 9 Average age of 5-year survivors was 56; of the entire series, 58 Average duration of

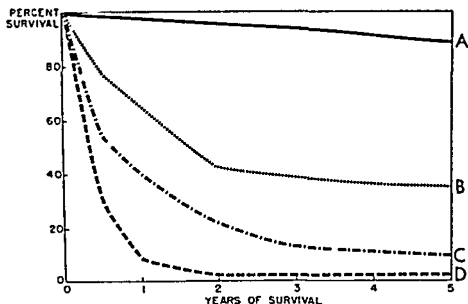


Fig 18 —Survival rates of cancer of lung *A*, survival in general population, *B*, cancer extirpated without extension beyond lung *C*, cancer extirpated with extension beyond lung *D* cancer not extirpated (Courtesy of Gibbon, J H, Jr, *et al* Ann Surg 145 637 641, May, 1957)

symptoms before treatment in the entire group was 69 months, and 5 months for 5-year survivors.

In 105 patients (72%), the tumors removed were epidermoid carcinomas, 79 of these patients survived operation Carcinoma was localized in 79, and 20 survived 5 years or more Only 5 of 36 patients with extension of epidermoid carcinoma beyond the lung lived 5 years Among 23 who survived operation for anaplastic tumors, 2 of 7 with localized lesions lived over 5 years Of 16 patients with anaplastic lesions extending beyond the lung, 2 survived 5 years Of 2 with adenocarcinoma confined to the lung, 1 survived 5 years, but there were no 5-year survivors among 6 with adenocarcinoma which had spread beyond the lung Neither

of 2 patients with alveolar cell carcinoma lived 5 years Of 65 patients with tumors (of all types) confined to the lung, 23 (35%) survived 5 years whereas only 7 (9%) of 80 with extensive lesions survived (Fig 18) Mediastinal lymph nodes were involved in 5 of the 7 and the inferior pulmonary vein in 2.

The most important single factor related to 5 year survival was the absence of tumor extension beyond the lung 5 year survival of patients with localized cancer was four times that of those whose cancer had spread beyond the lung Best results were obtained in patients with epidermoid carcinoma confined to the lung (37% 5-year survival) Although anaplastic carcinoma is reputed to have an extremely poor prognosis, 4 patients with this tumor survived over 5 years and in 2 of these, the tumor extended beyond the lung

► [Our experience provides almost identical figures to those reported by these observers —Ed]

Bronchial Carcinoma Effect of Radiotherapy on Survival was evaluated by J R Bignall[2] (London) in 207 patients and a comparison made with a matched series of 248 who received no treatment likely to prolong life Of the 207 irradiated patients, 114 received an estimated tumor dose of 1,000 3 900 r and 93 had 4,000 r or more No patient in either series was known to have extrathoracic metastases when the decision on treatment was made

The greatest differences between treated and untreated patients in duration of life from the first hospital attendance was found in those without mediastinal metastases treated with 4,000 r or more, 35% lived a year and 15% lived 2 years compared with 24% and 6% of the untreated patients In patients with mediastinal metastases, differences were less and pattern of survival of those treated with 1,000 3,900 r was almost identical with that of the corresponding untreated group

Evidence suggests that differences were not entirely due to selection and random-sampling variations, but were influenced by radiotherapy In this series, however, it is unlikely that radiotherapy caused an increase of as much as 10% in the proportion surviving a year after diagnosis or

(2) Lancet 1 8 6 87) June 9 1956

5% in those living 2 years, even in the most favorable patients treated with higher doses.

Results of Radiotherapy of Bronchial Cancer. L. H. Garland and M. A. Sisson[3] (Stanford Univ.) found that the average survival time after roentgen therapy alone in 122 patients with bronchogenic carcinoma was 6.2 months, ranging from 1 to 60 months. Average survival of 275 untreated patients was about 3 months less. In all the patients the cancers were considered inoperable or found to be unresectable. Radiotherapy in moderately heavy dosage (about 3,000 r tumor dose in 4 weeks or less) has a useful place in palliation of bronchogenic carcinoma. In heavy dosage (about 5,000 r in 4-5 weeks), it is occasionally curative.

Relief from symptoms for weeks or months was obtained in about two thirds of the treated patients, but marked improvement in only about 20%. Results were slightly better in patients with anaplastic tumors than in those with squamous cell growths. The response to radiotherapy was not predictable on histologic grounds; some well-differentiated squamous cell lesions responded better than some anaplastic tumors. Patients in poor general condition due to age, concurrent disease or distant metastases should not have radical radiotherapy. Palliative radiotherapy, judiciously applied, may often help these patients. Reports in the literature indicate that megavoltage and betatron therapy are about equally as effective as orthovoltage therapy (200-250 kv.) used in these patients.

THE HEART

Management of Wounds of Heart: Recent Series of 43 Cases with Comment on Pericardicentesis in Hemopericardium. Aubre de L. Maynard, Marcelino J. Avecilla and Emil A. Naclerio[4] (Harlem Hosp., New York) summarize their experiences with this series of penetrating heart wounds. Over-all mortality was 42%. In a few patients with massive

(3) Radiology 67 48 62, July, 1956
(4) Ann Surg 144 1018 1022, December, 1956

hemothorax presumably exsanguinating autopsy revealed a minimal or practically nonexistent hemopericardium In these instances hemopericardium was not the lethal factor but loss of blood probably was It seems therefore that some patients admitted in extremis are just as likely to be victims of exsanguination with a totally insignificant hemopericardium as of acute hemopericardium with cardiac tamponade

In pericardial aspiration whether by parasternal or costoxiphoid route clotted blood invariably encountered interfered with successful withdrawal of blood and successful decompression

Since 60 70% of the patients had additional serious wounds surgery *was performed on 32 Mortality rate* was 25% When the emergency surgical unit of a hospital is adequate surgery is probably the preferred therapy for serious cardiac wounds

► [*The management of penetra* [illegible] ome what controversial with two schools [illegible] ment in all cases and the other [illegible] dicentesis as specific therapy or as a preparatory measure to emergency *thoracotomy in patients in whom response to this method of treatment is* not maintained The authors of this article are proponents of the former method but their results can hardly be considered a strong recommendation for this form of management In this series of cases over all mortality was 42% and in their previously reported series it was 57% *Proponents* of the conservative approach including ourselves have reported comparable series in which conservative management was employed with a total mortality of approximately 25% Our own experience has led us to the conviction that operative treatment is necessary in *only about 25% of patients* with penetrating wounds of the heart —Ed]

Penetrating Gunshot Wounds of Heart Clinical Study of 88 Cases with a follow up period of 10 16 years was conducted by O Perasalo A N Kuusisto and J Larjanko[5] (Univ of Helsinki) Most patients were wounded by shell fragments The metal foreign body was lodged in the heart in 46 patients and in the pericardium in 42

Early symptoms were present in 68% of the patients but early signs only in 22% Some patients had tachycardia and extrasystoles Hemopericardium developed in 6 patients and definite systolic or diastolic murmurs in 8 Late symptoms were commoner There was only 1 patient without symptoms whereas 60 had more or less severe symptoms Late signs were rare the ECG showed late changes in only 1 patient

Complications occurred in 3 patients In 1 the shell frag

(5) Ann chir g naec Fenn ae vol 45 supp 1? 1956

ment wandered from the left ventricle into the epigastric artery, from where it was removed In the others the complications were lethal; 1 had pericarditis and died of encephalomyelitis, the other died of a myocardial infarct caused by a shell fragment injuring a coronary vessel

Surgery was performed on 10 patients; there was a large metal piece in the heart muscle in 2 and in the pericardium in 8 All recovered. Surgery appeared indicated when the foreign body was 0 5 cm or larger, in pericarditis or myocardial damage, or when severe subjective symptoms or neurosis followed the injury.

Myocardial Contusion. Harry W Hale, Jr. and J Walter Martin[6] (Buffalo) state that closed chest injuries are more common than injuries due to penetrating objects The heart is particularly subject to injury because it hangs freely in the chest cage and is suspended from one end Sudden accelerations or decelerations of the chest, compression of the heart between the sternum and the vertebral column or sudden violent increase in intrathoracic pressure can injure the heart A variety of pathologic lesions may occur in the heart and its associated structures as a result of closed trauma There may be small areas of petechiae or ecchymoses, either subendocardial or subepicardial The pathologic process may be damage of the muscle, with necrosis and scar formation The lesion may resemble myocardial infarction due to coronary occlusion Late results may include myocardial insufficiency or aneurysm dilatation Blunt injuries may cause arrhythmias, without anatomic evidence of damage

The clinical picture of myocardial contusion depends somewhat on the extent and type of lesion The patient may have pain, marked tachycardia, dyspnea and hypotension The ECG may show transient or longer-lasting disturbances of rhythm or evidence of pericarditis and focal muscular damage, as in typical myocardial infarction

Treatment is essentially that of the patient with coronary occlusion and myocardial infarction, except that anticoagulants are not given because of danger of hemorrhage into the heart muscle In mild cases, the patient may gradually be mobilized as symptoms subside and the ECG returns to nor-

(6) Am J Surg 93 558 564 April 1957

mal In more severe injuries, with ECG evidence of marked muscular damage, complete bed rest of 4-6 weeks is indicated Pronestyl® or quinidine may be used in patients with arrhythmias and if marked hypotension develops, norepinephrine may be necessary Digitalis is given only when decompensation develops Signs of cardiac tamponade should be watched for, especially during the 2d week.

Posttraumatic Constrictive Pericarditis R. de Vernejoul, P Buisson, R Courbier and R Tricot[7] report a case successfully treated by pericardiectomy in a man 31, who had a stab wound in the left thorax They review 26 previously published cases of constrictive pericarditis following trauma

Reaction of the serous pericardial membrane to injury is the same as that of the pleura, i e, traumatic and purulent inflammation may develop into constrictive pericarditis Pericardiectomy is the treatment of choice and resection performed through the transpleural route or by sternotomy should be as complete as possible without necessarily being total Timing the operation is not so difficult as in bacillary constrictive pericarditis Once the pericardial shell has been formed, it should be removed Calcification implied a poorer prognosis If injury is accompanied by a heart wound the myocardial scar is a serious risk Posttraumatic myocarditis may explain some early postoperative deaths

Surgical intervention during the initial stage, when there is pericardial effusion, in a sense constitutes preventive treatment of chronic constrictive pericarditis In severe injuries of the thorax, hemopericardium must be watched for because it can easily be overlooked Repeated punctures drain the effusion If these are ineffective and effusion recurs operation is necessary Cleansing of the pericardial cavity and aspiration permit rapid drainage of the effusion If operation is performed later, when lesions of the pericardial membrane are already present, hemopericardium should be regarded initially as constrictive pericarditis and pericardiectomy should be performed Purulent pericarditis which develops into the chronic constrictive type, is treated by pericardiectomy after the acute condition has subsided If antibiotics do not arrest the acute infection, drainage is indicated until a favorable time for pericardiectomy

(7) Presse méd 65 241 243 Feb 9 1957

Constrictive Pericarditis: Review and Long-Term Follow-up of 78 Cases (59 men and 19 women) are reported by John C Dalton, R J Pearson, Jr, and Paul D White[8] (Massachusetts Gen'l Hosp) Age of apparent onset varied between 2 and 78

Dyspnea on exertion, ankle edema and abdominal swelling are the most frequent complaints at onset and as the disease progresses Neck vein distention and hepatomegaly are the most frequent physical findings Pleural effusion was present in 50% of patients, ascites in 47% Systolic blood pressure above 130 mm Hg was found in only 1 patient preoperatively, but wide pulse pressures were not rare Systolic blood pressures commonly rose postoperatively, but no patient became seriously hypertensive Cardiac enlargement was present in one half the patients, cardiac pulsations were diminished in four fifths Calcium was found in the pericardium at x ray study, operation or autopsy in 60%

Every patient had an abnormal ECG with abnormal T waves The P waves were abnormal in 72% of those with normal rhythm Atrial arrhythmias occurred in 34 patients, fibrillation was identified in 27, being constant in 19 A low QRS (amplitude of less than 5 mm in all 3 standard limb leads) was observed in 55%

Characteristic cardiac catheterization findings are moderately low resting cardiac output, elevated pulmonary capillary pressure, early diastolic dip and plateau pattern in the right ventricular pressure tracing, elevated and relatively uniform pulmonary wedge, pulmonary artery diastolic, right ventricular end diastolic and right atrial and vena caval pressures

Among 61 patients who had their first surgery for constrictive pericarditis there were 7 operative deaths (11 4%) Of 7 patients who had repeated operations, 2 died during the procedure Forty two patients who had surgery are still living, all patients followed over 20 years are living normal unrestricted lives Surgery gave excellent results in 50% and failed in about 7%

Treatment of Cardiac Arrest Occurring during Surgery is discussed by Jerome H Kay, Richard Dever, Robert A Gaertner and George C Kaiser[9] (Nat'l Inst of Health) Car-

(8) Ann Int Med 45 445-458 September 1956
(9) J A M A 163 165 167 Jan 19 1957

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(7) Presse méd 41 43 Feb 9 1957

Constrictive Pericarditis Review and Long-Term Follow-up of 78 Cases (59 men and 19 women) are reported by John C Dalton, R J Pearson, Jr, and Paul D White[8] (Massachusetts Gen'l Hosp) Age of apparent onset varied between 2 and 78

Dyspnea on exertion, ankle edema and abdominal swelling are the most frequent complaints at onset and as the disease progresses Neck vein distention and hepatomegaly are the most frequent physical findings Pleural effusion was present in 50% of patients, ascites in 47% Systolic blood pressure above 130 mm Hg was found in only 1 patient preoperatively, but wide pulse pressures were not rare Systolic blood pressures commonly rose postoperatively, but no patient became seriously hypertensive Cardiac enlargement was present in one-half the patients, cardiac pulsations were diminished in four fifths Calcium was found in the pericardium at x ray study, operation or autopsy in 60%

Every patient had an abnormal ECG with abnormal T waves The P waves were abnormal in 72% of those with normal rhythm Atrial arrhythmias occurred in 34 patients, fibrillation was identified in 27, being constant in 19 A low QRS (amplitude of less than 5 mm in all 3 standard limb leads) was observed in 55%

Characteristic cardiac catheterization findings are moderately low resting cardiac output, elevated pulmonary capillary pressure, early diastolic dip and plateau pattern in the right ventricular pressure tracing, elevated and relatively uniform pulmonary wedge pulmonary artery diastolic, right ventricular end diastolic and right atrial and vena caval pressures

Among 61 patients who had their first surgery for constrictive pericarditis, there were 7 operative deaths (11 4%) Of 7 patients who had repeated operations, 2 died during the procedure Forty two patients who had surgery are still living, all patients followed over 20 years are living normal, unrestricted lives Surgery gave excellent results in 50% and failed in about 7%

Treatment of Cardiac Arrest Occurring during Surgery is discussed by Jerome H Kay, Richard Dever, Robert A Gaertner and George C Kaiser[9] (Nat'l Inst of Health) Car-

(8) Ann Int. Med 45 445-458 September 1956
(9) J A M A 163 165 167 Jan 19 1957

massage alone, the treatment of choice is electric defibrillation Two large electrodes, at least 7 cm in diameter, are placed firmly one on each side of the ventricular mass and a single shock, as short as possible, is given If this is not effective, a series of 3-5 short shocks are given The heart then goes into asystole, after 10-15 seconds, regular beats are seen If asystole persists, further massage often restores the beat

Cardiac Arrest at Work—Penknife Thoracotomy with Recovery. C David Brown, Joel Knudson and George F Schroeder[2] (Lutheran Deaconess Hosp, Chicago) report on *successful resuscitation of a patient who apparently died of* cardiac arrest

Man, 24, while working in hospital darkroom, suddenly collapsed No heart sounds were audible Artificial respiration was started With a pocketknife, an incision was made between the left 4th and 5th ribs and the 4th costal sternal junction was severed No bleeding occurred The heart was at a standstill and apparently arrested in systole After about 1 minute of manual systole, the heart began to fibrillate Oxygen administration was started After the patient was transferred to the operating room, tracheal intubation was performed and oxygen given under pressure About 4 minutes had elapsed before thoracotomy, 5 minutes before fibrillation began and 8 minutes before tracheal intubation Fluids were given intravenously, including 60 cc of 1% procaine

Since fibrillation did not stop after 90 minutes and a defibrillator was not available, potassium chloride was injected into the right atrium, with resulting complete standstill As calcium gluconate did not restart the heart, manual systole was initiated, which led again to fibrillation After 135 minutes, fibrillation was still present and a third attempt was made, using potassium chloride alone The heart came to complete standstill again, and after about 30 seconds, compression was restarted This time, the heart began to beat regularly and has continued in regular rhythm The pericardium was partially closed the collapsed lung reinflated and the chest cavity closed Signs of shock rapidly disappeared, after 24 hours, the patient was able to talk He returned to full activity in 2 months As of 22 months after the episode, he had shown no signs of mental or emotional abnormalities nor impairment of any vital function

► [This is a truly remarkable case and dramatically illustrates the importance of perseverance in dealing with this problem —Ed]

Structural Changes in Heart Resulting from Cardiac Massage in 14 patients who died subsequently were studied by George H Peddie, Oscar Creech, Jr, and Bela Halpert[3]

(2) J A M A 163 352 353 Feb 2 1957
(3) Surgery 40 481 487 September 1956

Seven died immediately of cardiac arrest, 1 after 6 hours and the rest 10 79 days later Of the last, 3 died of cardiac arrest and 3 regained consciousness and later died of their primary disease

In all instances in which massage lasted more than 15 minutes there was evidence of some damage to the myocardium and pericardium Rupture of the myocardium occurred in 1 instance after 90 minutes of massage On the other hand, pericardial reaction, noted in 9 cases, developed irrespective of the duration of massage and was not confined to cases in which the pericardium had been opened It is likely that manipulation of the heart and intracardiac injection of various agents are sufficient to produce pericarditis No conclusions could be drawn from the use of the defibrillator in regard to cardiac damage

Since cardiac massage is usually initiated hurriedly, manipulation tends to be vigorous and serious injury may fol low when massage is continued more than 15 minutes However, it may be prolonged safely if performed carefully

Emergency Treatment of Air Embolism is suggested by Morris J Nicholson and Joseph P Crehan[4] (Lahey Clinic) (1) Withdraw the needle as soon as symptoms appear, or close the opening in the vein should air enter at the opera tive site (2) Lower the patient's head to prevent air from entering the cerebral circulation in case arterial embolism may have occurred (3) Place the patient in the left lateral posi tion to release the air block Should these measures fail, an emergency thoracotomy must be done in 2-3 minutes from the time circulation ceases to permit cardiac massage and displacement of air from the right side of the heart into the lungs or its aspiration by a needle and syringe, which will allow return of normal cardiac function Maintenance of a clear airway and establishment of continued, effective arti ficial respiration with oxygen are essential

If air has entered the left side of the heart through a patent foramen ovale or a congenital interventricular septal defect or has been introduced directly into the pulmonary artery air ultimately may have been expelled into the aorta and have entered the coronary arteries, blocking circulation of

(4) Anesth & Analg 35 634 643 Nov Dec 1956

oxygenated blood to the myocardium Experiments have shown that air trapped in the coronary vessels of a dog can be forcibly expelled by appropriate treatment, and an otherwise certain cardiac fatality be turned into a survival Patients surviving venous air embolism may show ECG evidence of right heart strain Routine use of serial ECG's might be a useful guide during treatment

Percutaneous Left Ventricular Puncture in Assessment of Aortic Stenosis. In assessment of patients for aortic valve

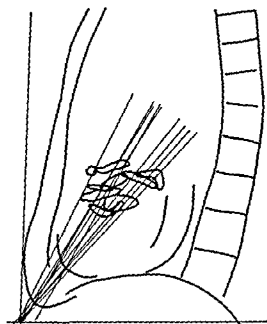


Fig 19—Composite drawing of lateral views of 9 hearts in cases of aortic stenosis A line has been drawn from apex through center of area of valve calcification in each case Angle varies from 24 to 42 degrees with a mean of 35 degrees (Courtesy of Brock R, *et al* Thorax 11 163 171, September, 1956)

surgery, standard methods of investigation are of limited value They cannot indicate whether, in a patient with signs of pure aortic stenosis, symptoms such as angina or dyspnea are due to aortic stenosis or to associated coronary or pulmonary disease Neither can they show whether, in a patient with a mixed lesion, aortic stenosis or regurgitation is dominant Further information in such cases might be obtained by measuring the systolic pressure gradient across the aortic valve This has been done routinely at operation for aortic stenosis

Russell Brock, B. B. Milstein and D. N. Ross[5] (London) developed a method of measuring the gradient by direct puncture of the left ventricle through the intact chest wall and simultaneous brachial artery puncture. The axis of the outflow tract was found to correspond with a line drawn from the apex of the heart to the 2d right costochondral junction and inclined backward at an angle of about 35 degrees to the sternum (Fig. 19). A needle inserted in this line has a better chance of entering the left ventricular chamber than one passing across the outflow tract, particularly in aortic steno-



Fig 20 —Anteroposterior and lateral x rays taken during left ventricular puncture and right heart catheterization Ventricular needle and cardiac catheter can be seen. Note that in anteroposterior view needle is directed toward 2d right costochondral junction In this case posterior angulation of needle is about 30 degrees (Courtesy of Brock, R, *et al* Thorax 11 163 171, September, 1956)

sis in which the ventricular muscle is very thick and the cavity small, especially in systole. There seems to be less chance of damage to a coronary vessel since these are small in the region of the apex of the ventricles. These observations on the line of the outflow tract were checked by taking x-rays of the needle in position in the heart during left ventricular puncture (Fig. 20).

Technic—The patient is given premedication as for a cardiac catheterization and lies supine. An electrocardiograph is connected in every instance, and instruments are available for emergency thoracotomy, cardiac resuscitation and aortic valvotomy. A percu-

(5) Thorax 11 163 171, September, 1956

taneous brachial artery puncture is performed The front of the chest is draped to expose the area from the right of the sternum to *the midaxilla and from the clavicle to the costal margin* The position of the apex beat and of the 2d right costochondral junction is then marked on the skin The skin about 2 cm below and lateral to the apex beat is infiltrated with local anesthetic solution, and the infiltration is carried down to the pericardium One or two extrasystoles indicate that the needle has penetrated the myocardium If these are seen, no more procaine should be injected at this depth the needle should be withdrawn a short distance if any more is required Injection of procaine into the myocardium may precipitate ventricular fibrillation A no 18 gauge needle 12 5 cm long is connected to the electromanometer and heparinized saline run slowly

PRESSURES AT VENTRICULAR PUNCTURE AND AT OPERATION (IN MM HG)

Case No	Left Ventricular Puncture			Operation		
	L.V Pressure	B A Pressure	Gradient	L V Pressure	Aortic Pressure	Gradient
1	165/10	130/70	35	155/10	70/45	85
2	145/10	100/45	45	155/10	65/30	90
5	*220/10*	*100/60*	*120*	*195/25*	*80/45*	115
6	170/10	95/60	75	135/15	70/50	65
9	255/10	130/90	125	165/15	55/30	110
12	245/15	185/105	80	250/30	200/100	50
15	150/12	115/75	35	175/25	150/100	25
16	220/15	100/60	120	200/20	80/50	120
18	200/25	80/50	120	200/45	95/60	105
19	205/20	140/80	65	160/20	80/45	80
20	260/40	150/70	110	175/35	85/65	90
22	*170/15*	*95/45*	*75*	*145/15*	*75/45*	70

through it The needle is inserted at the apex and directed toward *the 2d right costochondral junction with a backward* inclination of about 35 degrees It is advanced until the left ventricle is just felt impinging on the needle tip and it then enters the ventricle Precautions must be taken to avoid air embolism The needle is lightly *supported between the fingers while synchronous or immediately* consecutive left ventricular and brachial artery tracings are recorded The needle is then withdrawn and the skin puncture covered with a simple dressing The needle is not as a rule in the heart for *more than 3 4 minutes, and apart from one or two extrasystoles as* the ventricle is penetrated there are no further arrhythmias while the needle is in position so long as it is kept still There is no distress and little sensation of pain or discomfort is felt by the patient *X-rays are taken routinely before the patient is returned to the* ward, to exclude pneumothorax or blood in the pleura or pericardium

The authors performed this procedure on 24 patients without serious complications In addition, 15 patients had had right heart catheterization In 12 instances diagnosis was confirmed at operation when the gradient was compared with the figure obtained at left ventricular puncture (table) In general, there was reasonably close correlation between the observations made before and at operation

► [This method appears to be simpler than left heart catheterization by passing a catheter into the left atrium through a cannula inserted posteriorly It is somewhat surprising, however, that the authors encountered no complications from the procedure —Ed]

Dye Dilution Curves from Left Heart and Aorta for Localization of Left-to-Right Shunts and Detection of Valvular Insufficiency were determined in 33 patients by Eugene Braunwald, Herbert L Tanenbaum and Andrew G Morrow[6] (Nat'l Inst of Health) The technic used consists of rapid injection of an indicator dye into the chambers of the left heart or aorta and recording of a dilution curve from a peripheral artery

In absence of any left to right shunt or of valvular regurgitation on the left side of the heart, rapid injection of an indicator into the left atrium left ventricle or thoracic aorta yielded a primary curve with sharp rapid ascent and slightly slower descent When injection was made proximal to the site of a left-to right shunt, that fraction of indicator which passed through the pulmonary circulation distinctly interrupted the smooth, rapidly descending limb of the primary curve, with an abrupt decline in rate of fall in concentration However, when indicator was injected distal to the site of the shunt, a normal curve was obtained Thus, by selectively injecting indicator into various sites, the location of the left-to right shunt could be precisely determined When injection was made immediately distal to an insufficient valve, a portion of indicator washed back and forth, resulting in a dilution curve with rapid ascent, but distinctly prolonged, generally smooth uninterrupted descent

In the 33 patients studied, no complications resulted from left heart or arterial catheterizations The technic proved particularly useful in distinguishing between (1) interventricular septal defect and aortic septal defect; (2) aortic sep-

(6) Proc. Soc. Exper Biol & Med 94 510 512 March 1957

tal defect and patent ductus arteriosus, (3) aortic valvular disease and ruptured aneurysm of sinus of Valsalva, and (4) aortic and pulmonic insufficiency Another application has been in determining presence or absence of an interventricular septal defect or of mitral insufficiency in patients with known interatrial septal defects, i e , establishment or exclusion of diagnosis of a common atrioventricular canal In patients with anomalous pulmonary venous drainage, presence or absence of an interatrial septal defect has been determined

Technic and Sequelae of Catheterization of Left Side of Heart Marianne Bagger, Viking Olov Bjork and Gunnar Malmstrom[7] (Stockholm) developed the technic of puncturing the left atrium with a needle through the 8th intercostal space in the right posterior portion of the thorax This permits the introduction of a fine plastic catheter through the needle down into the left ventricle and out into the aorta Thus a complete left heart catheterization with measurements of the pressure gradient across the mitral and aortic valves can be performed The puncture technic also permits rapid injection of contrast medium in the left atrium for outlining the mitral valves during the heart cycle which has proved to be of practical value In difficult cases, especially those with combined lesions, this method of left-heart catheterization, if necessary combined with angiocardiography, is of great clinical help

Pleuritic pain, extrasystoles, slightly elevated temperature and a small amount of blood in the pericardium are commonly encountered after a left heart catheterization These sequelae are brief and not counted as complications Major complications are heart tamponade, ventricular fibrillation and cerebral embolism Minor complications are a small pneumothorax, hemoptysis and pleural effusion

Among 150 patients with mitral stenosis, major complications were observed in 11 (7%) No death occurred in this group and no patient had persistent sequelae Among 17 patients with aortic valvular disease, there were 3 major complications including cardiac tamponade with ventricular fibrillation

In a small left atrium, the puncture may be performed with

(7) *Am Heart J 53 91 99 January 1957*

the aid of fluoroscopy When angiocardiography is performed, the patient must be well oxygenated during and after anesthesia The complications in this group seem more related to anesthesia than to actual injection of contrast media Some complications cannot be avoided Therefore, left-heart catheterization is advised only when its diagnostic help is necessary for the decision of eventual surgical exploration

Hypothermia for General and Cardiac Surgery. With Technics of Some Open Intracardiac Procedures under Hypothermia Hypothermia is the physical state of a homothermic person whose body temperature is below the accepted normal range for that person Currently, there is ample knowledge and experience in man with body temperatures in the range of 37 C -20 C only The fundamental physiologic effect of hypothermia is a progressive fall in the metabolic rate of all tissues The greatest dangers of hypothermia between 20 C and 30 C are disturbance in cardiac rhythm and hemorrhagic diathesis Nonlethal complications include protracted ileus of the gastrointestinal tract, occasional superficial burns if diathermy or hot water mattresses are used and peripheral neuritis if ice water surface cooling is used

The following management of hypothermia is suggested by Henry Swan[8] (Univ of Colorado).

TECHNIC —Preparation of patients for hypothermic anesthesia is essentially similar to any anesthetic procedure Morphine, Demerol®, barbiturates and scopolamine are given for premedication Induction is usually with ether Two intravenous cannulas are placed to assure that this route for fluids or blood will be available ECG needle electrodes are connected, and a rectal thermocouple is inserted Throughout the induction and cooling period, a surgeon is available for cardiac resuscitation if the need arises When in second-plane, third stage anesthesia, the patient is placed in a tub of tepid water, except for the head and arms If shivering ensues, curare is given When vital signs are stable, ice cubes are added to the water Hyperventilation is deliberately performed throughout the anesthetic experience, except during circulatory occlusion The patient is removed from the tub when rectal temperature has reached a point which is about two thirds the desired fall To cool an infant requires about 10 15 minutes in the tub, an obese adult may need as long as 60 75 minutes

The patient is removed from the tub and thoroughly dried The pelvic area is wrapped with 1 in felt, which is taped in place A standard diathermy coil is then accurately placed, with the patient

(8) S Clin North America 36 1009 1024 August 19 6.

so supported that his weight does not lie on the coils Diathermy is used to counteract a tendency to overdrift in cooling and to warm the patient immediately after completion of the cardiac procedure Blood replacement is begun early, with transfusion slightly in excess of loss About half the patients show auricular fibrillation when they enter the high 20 s (C) This is not considered serious most revert to sinus rhythm at about the same temperature when rewarming

About 5 minutes before the moment of circulatory occlusion further curare is given to prevent contraction of the diaphragm Blood pH is determined at this time The patient should be in respiratory alkalosis, with pH 7 5 or more During occlusion the lungs are allowed to collapse completely and respiration is discontinued The surgeon occludes inflow of blood to the heart then after a few seconds occludes the aorta about 1 in distal to the valve and injects 0 5 1 5 ml neostigmine 1 4000 into the base of the aorta to perfuse the coronary system After another 10 15 seconds the operative manipulation is performed

On release of circulatory occlusion the lungs are again ventilated with oxygen and hyperventilation resumed The patient may receive only oxygen until the end of the procedure If further anesthetic agent is needed it is usually 50 50 nitrous oxide oxygen

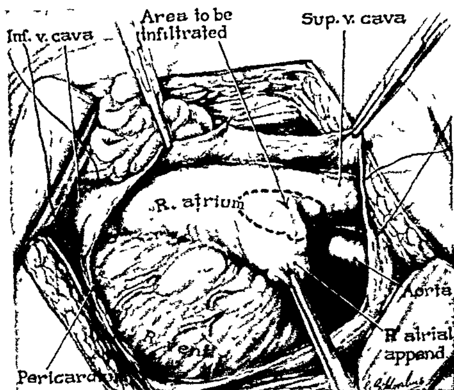
Diathermy is begun immediately after restoration of circulation applied intermittently (1 minute off and 2 on) to help prevent skin burns Auscultable blood pressure of 90 systolic or above should be achieved before the thoracotomy is finally closed to avoid later bleeding when the hypotension of hypothermia rises to normal levels After closure the patient may or may not be further warmed in the tub filled with water at 45 C depending on temperature The endotracheal tube is removed when spontaneous respirations appear adequate The usual temperature at waking is about 34 C

The immediate postoperative period is extremely critical Evaluation of effective circulating blood volume and myocardial function is extraordinarily difficult A few instances of severe shock occurred during this period Blood volume studies are done at this time for comparison with preoperative levels

► [This investigator has made a valuable contribution to open heart surgery with the use of hypothermia for this purpose There are however certain disadvantages to this method including particularly the brief period of safe cardiac inflow occlusion the tendency to serious cardiac arrhythmias and the frequency and danger of air embolism For these reasons and in light of the development of relatively safe and efficient pump-oxygenators there is a strong trend toward the use of the latter to replace hypothermia as a more satisfactory solution to the problems of open heart surgery —Ed]

Prevention of Ventricular Fibrillation in Experimental Hypothermia Procaine Infiltration of Superior Atriocaval Junction Leo R Radigan Thomas A Lombardo and Andrew G Morrow[9] (Nat l Inst of Health) reduced the body

(9) Surgery 0 4 1 4 4 September 1956



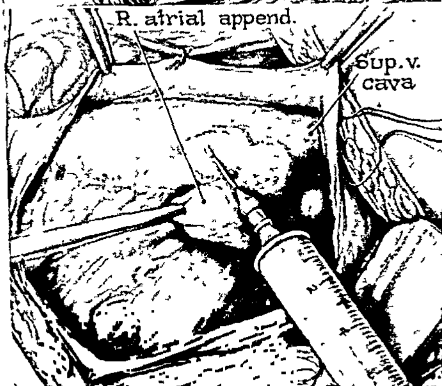


Fig 21 (top) —Superior atriocaval junction and area to be infiltrated with procaine

Fig 22 (bottom) —Technic of atriocaval infiltration Confluent subepicardial wheals are raised as in intradermal injection

(Courtesy of Radigan, L R, *et al* Surgery 40 471-474, September, 1956)

temperature of 48 dogs to between 78.8 and 82.4 F., opened the chest, placed tapes about the superior and inferior venae cavae and infiltrated the superior atriocaval junction of 20 dogs (Figs. 21 and 22) with 5 cc. of 1% procaine, 8 dogs were given 1% procaine intravenously or intrapericardially, and 20 dogs served as controls. Venous inflow was occluded for 8 minutes and a standard right ventricular operation was performed in all. In animals in which ventricular fibrillation occurred, cardiac massage was carried out for 10-20 seconds and the heart defibrillated with an electric shock of 130 volts. All animals were rewarmed in a water bath to a body temperature of 96.8 F.

Of the 20 control dogs, 18 had ventricular fibrillation. All were easily defibrillated, but 3 died during surgery and 10 within 24 hours—a mortality rate of 65%. In none of the dogs that had procaine infiltration did ventricular fibrillation develop, but 1 died 24 hours postoperatively. Surviving animals of both groups exhibited no cardiac or neurologic sequelae. All animals that received procaine intravenously or intrapericardially had ventricular fibrillation and were killed at the end of the experiment. The injected procaine was effective in preventing ventricular fibrillation through its action on the extrinsic cardiac nerve fibers.

Cardiac Surgery with Hypothermia and Acetylcholine Arrest is discussed by Peter V. Moulder, Richard G. Thompson, Curtis A. Smith, Barry L. Siegel and William E. Adams[1] (Univ. of Chicago). Total body hypothermia protects vital organs from prolonged periods of oxygen deprivation. The suppression of metabolic activity that is the basis for this and the sensitive temperature modalities of cellular enzymatic reactions suggest real hazard associated with the use of temperatures far from body normals. Holding the period of circulatory stasis to a minimum has prevented cerebral, renal and hepatic complications. The major complication has been ventricular fibrillation.

There are 3 approaches to protect the heart with hypothermia: stopping or profoundly inhibiting cardiac activity during circulatory stasis to diminish useless metabolic activity, giving oxygen to the myocardium during the cardiotomy and

(1) J. Thoracic Surg. 32:360-371, September, 1956.

decreasing cardiac sensitivity with antifibrillatory drugs

The authors cooled 12 dogs and subjected them first to 1 minute of occlusion alone, then, following cardiac stabilization, to 10 minutes of occlusion with intracoronary acetylcholine (100 mg) followed by 0 6 mg atropine sulfate and disocclusion The average normal cardiac rate of 164 fell to 71 with the hypothermia (25 C), remained about the same with occlusion alone for the 1 minute, but fell to an average of 7 during the 10 minutes under acetylcholine, shortly after atropine and disocclusion, the average rate returned to 81 Surgical procedures induced added contractions, usually to a total of 10/minute Compared to those of the unmodified heart, the ECG in these animals showed less abnormality when return rhythm was attained, and most striking, the heart remained pink

There were 62 dogs that underwent hypothermia with acetylcholine inhibition of heart activity for 5 37 minutes There was a high incidence of fibrillation, in most instances following surgical procedures and most were reversible Intractable (or constantly recurring) fibrillation occurred in 9 dogs, in 4 with direct coronary artery work Deaths during rewarming were from hypotension, arrhythmia and undiagnosed pneumothorax

Open heart surgery in humans was limited to 5 patients each with a different lesion ostium secundum and ostium primum interatrial defects, atrioventricularis communis, aortic stenosis and a unique form of interventricular septal defect The first 4 patients had hypothermia and acetylcholine inhibition of the heart Ventriculotomy was performed with a coronary perfusion of oxygenated blood at the rate of 2 ml /kg body weight/minute containing 100 mg acetylcholine/500 ml perfusate All hearts were slowed by acetylcholine, however, the huge heart in the patient with the aortic valvular stenosis started recovering from inhibition in about 3 minutes At no time did these patients show arrhythmia during the cooling period Blood in the surgical field was visibly well oxygenated and the hearts were pink at cardiotomy Technically, the work in the first 4 patients was done in a dry, quiet field In the ostium primum heart it was possible to do careful suturing on the septal brim above the nodal and conduction tissue, and this patient has shown

no rhythm disturbance in the 6 months since surgery In the fifth patient in whom coronary perfusion was performed the heart was quiet, but the presence of the returning blood proved strikingly different from the other bloodless cardiotomies With minimal contractions and the low temperature, it was conspicuous that the cardiac venous blood was red shortly after perfusion was started (at only 2 ml blood/kg body weight/minute)

Hypothermia is discussed by E J Delorme[2] (Univ of Edinburgh) Hypothermia involves widespread disturbances of physiology which become more difficult to reverse as hypothermia is prolonged That oxygen consumption invariably falls during cooling is true only when the response to surface cold is skilfully controlled by the anesthesia

Of the physiologic disturbances met with in cooling, cardiac arrhythmia is the most important clinically Ventricular fibrillation is uncommon in simple cooling, but becomes more frequent when the cold heart is manipulated or incised Because of possible arrhythmias, continuous ECG observation during induction must be available The reflex and local effects of surface cooling can be avoided by perivascular cooling Optimal anesthesia with minimal anesthetic is also obtained by this method

Light hypothermia (95-86 F) is adequate for various hypoxic states, and wider use of this method is recommended for the simplicity of its technic, the degree of protection afforded and the negligibility of risk

It has been repeatedly observed that many patients undergoing major surgery during hypothermia appear to stand the operation well, only to show progressive deterioration during the later stages of rewarming When these histories are analyzed, it is often found that body temperature has been restored to or even above normal levels while blood pressure and circulation were still inadequate to supply oxygen at the required rate Deep hypothermia (68 59 F) is still in the experimental stage

High Atmospheric Pressure as Aid to Cardiac Surgery The amount of oxygen in physical solution increases greatly when the atmospheric pressure is raised If oxygen is inhaled

(2) Anaesthesia 11 221 231 July 1956

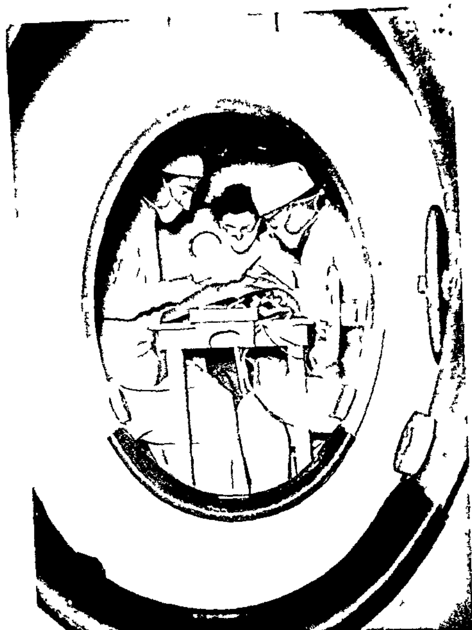


Fig 23 —Surgeons and anesthetist ready for work in tank Doors must be closed, after which pressure is brought up to 3 atmospheres absolute (Courtesy of Boerema I, *et al* Arch chir neerl 8 193 211, 1956)

at 3 atmospheres absolute pressure, then the amount of oxygen in physical solution probably is 15 times as much as is found in blood normally This oxygen is completely available and independent of the dissociation curve Because the oxygen requirements of the body are reduced by 50% at 27 C, a person at 27 C breathing pure oxygen at a pressure of 3 at-

mospheres absolute probably does not require hemoglobin The utilized oxygen is replaced by physical solution in the blood as the lungs are traversed Moreover, this great increase in oxygen in solution is found not only in the blood but also in the extracellular fluids and probably even in the cells The tissues thus have a large store of oxygen available when the circulation is arrested

I Boerema, J A Kroll, N G Meyne, E Lokin, B Kroon and J W Huiskes[3] (Amsterdam) did experimental surgery in a high pressure tank at 3 atmospheres absolute No damage to cerebrum or heart was observed, neither was there an increase in excitability of the myocardium—rather, the contrary At pressure of 3 atmospheres absolute, operators can work safely Intrathoracic operations were performed under the same conditions as those which prevail in a normal operating room (Fig 23)

The authors believe that with the use of a high pressure it may be possible to provide an adequate circulation and oxygenation of the heart muscle, even if the total blood volume were to be replaced by a clear fluid, e g, plasma, provided ventilation with oxygen at 3 atmospheres absolute was applied Should this be possible, clamping of the in- and outflow of the heart, a bypass or an oxygenator would no longer be necessary, the heart could be opened under a clear fluid and operated on through it, without danger of anoxia and air embolism

► [This is a rather ingenious approach to the problem of open heart surgery and somewhat reminiscent of Sauerbruch s negative pressure chamber for intrathoracic operations Like the latter it seems to raise more problems than it solves —Ed]

Causes of Death in 1,000 Operations for Congenital Heart Disease Willis J Potts, William O McQuiston and Thomas G Baffes[4] (Northwestern Univ) report 90 deaths in 1,000 operations for congenital heart disease (table) Of 44 deaths in cyanotic patients, the causes were brain damage 9, heart failure 7 lung complications 7, blood loss and shock 6, occlusion of ductus arteriosus during anastomosis 5, postoperative infection 3 too large anastomosis 3, improper procedure 2 and embolus and thrombosis of anastomosis 1 each Of 36 patients with exploratory operations, most of whom were

(3) Arch chir neerl 8 193 211 1956
(4) A M A Arch Surg 73 508 516 October 1956

cyanotic, 15 died, usually of hypoxia and heart failure. Among 15 with transposition of the great vessels, there were 13 deaths, all nonpreventable and due to continued cyanosis and heart failure. All of 347 patients with patent ductus arteriosus survived surgery. The 2 deaths in the group with aortic coarctation were due to fibroelastosis in 1 and right heart failure in the other. Of 25 patients with anomalies of the aortic arch, 6 died, 1 of a persistent posterior arch and the other of hemorrhage. Two died because of difficulties with anesthesia, since the anomalous vessel was too great to allow

DEATHS IN 1,000 OPERATIONS FOR CONGENITAL HEART DISEASE

	No.	Deaths	Mortality %
Cyanotic group			
Tetralogy of Fallot			
8 days to 3 yr.	196	30	15.3
3-16 yr.	220	8	3.6
Tricuspid atresia			
13 days to 3 yr.	24	5	20.8
3-16 yr.	8	0	0
Isolated pulmonary stenosis			
23 days to 16 yr.	61	1	1.6
Totals	500	44	8.8
Exploratory	36	15	42.0
Transposition of great vessels	15	13	86.6
Noncyanotic group			
Patent ductus arteriosus			
28 days to 16 yr.	347	0	0
Coarctation of aorta	52	2	3.8
Anomalies of aortic arch	25	6	24.0
Interatrial septal defect	5	1	20.0
Miscellaneous group	11	9	81.8
Grand totals	1,000	90	9.0

adequate tracheal intubation. Two died of tracheotomy complications. The 1 death in the interatrial septal defect group was due to fatal pulmonary edema.

The abnormal physiologic state of anesthesia is often a contributing factor in death. Traumatic intubation, laryngospasm, periods of hypoxia or hypercarbia, hypotension or hypertension and other factors can cause death in a poor-risk patient. Cyclopropane is the best anesthetic agent if administered by the to-and-fro absorption technic with controlled respiration. Lowering the body temperature has been rou-

tine during operation on cyanotic children The term "cardiac arrest" is often used as the cause of death in congenital heart disease patients when the actual cause is something more definite The causes of death cover a wide range of those due to human frailties, such as oversights, poor judgment and inexperience, and those due to irremediable pathology

Five-Year Postoperative Results of First 500 Patients with Blalock-Taussig Anastomosis for Pulmonary Stenosis or Atresia are presented by B Daniel White, Dan G McNamara, S Richard Bauresfeld and Helen B Taussig[5] (Johns Hopkins Univ) The 5 8 year follow-up revealed that 81 patients died at or within 6 months of operation, 30 had exploratory thoracotomies only, 389 survived 6 months or longer Complete information was available on 244 patients who were originally improved by a Blalock-Taussig anastomosis, 226 of these obtained good results and 18 fair results from the first anastomosis A good result means that after operation exercise tolerance is virtually normal and red blood cell count, hemoglobin and hematocrit have returned to nearly normal levels A fair result means that although the patient showed some improvement after operation, he still suffered from limitation of exercise and polycythemia Good results have been maintained in 67% of the patients 5-8 years after surgery and in 7% results are fair, 4% are no longer improved, 9% of those originally improved have required and survived a second operation, and 14% died between 6 months and 8 years after operation A higher percentage of patients in the tetralogy of Fallot group have maintained good results postoperatively than those in the group with other heart malformations, and mortality rate is significantly lower in the former group

Of the 163 patients with good results who were analyzed for changes in cardiac size, in the hemogram, and in arterial oxygen saturation, 126 are excellent in all respects Considerable, but not progressive, cardiac enlargement is present in 23, 14 patients have moderate, but not progressive, polycythemia Most of the patients have a good continuous murmur Absence of a continuous murmur usually indicates that the anastomosis is no longer functioning

(5) Circulation 14 1 519 October 1956

The best time for surgery is at age 8-12, 80% of the patients in this age group have maintained improvement 5 8 years after operation

The incidence of subacute bacterial endocarditis in the late postoperative group was 6% Of the 226 patients who originally obtained good results, 11% have died, and of the 18 with fair results, 44% have died Of the 33 patients who died, 19 were no longer improved, 6 were losing ground and 8 were doing well at time of death No patient with a tetralogy of Fallot died of cardiac failure

A patient with pulmonary stenosis or atresia who obtains a good result from a Blalock-Taussig anastomosis has a 67% chance of maintaining that improvement 5-8 years after operation If the patient has a tetralogy of Fallot, his chance for maintenance of improvement increases to 69%, but if he has other malformation, his chance is 50% The late mortality rate is significantly higher for patients with other malformations than for those with a tetralogy of Fallot There is about a 20% chance a patient will need a second operation A patient with a small heart is more likely to show cardiac enlargement after operation than one with a heart at or above the upper limit of normal at time of operation

Patients whose red blood cell count remains below 6,500,000, hemoglobin below 17 Gm and hematocrit below 55% have an excellent long-term prognosis A patient with these findings who has a tetralogy of Fallot and a cardiothoracic ratio of 50% or less has an especially good prognosis

► [This is an excellent analysis of an important series of cases providing good evidence of the long term value of the Blalock-Taussig operation for tetralogy of Fallot With the increasing use of extracorporeal circulation however, open repair of the defects in tetralogy will gradually be done with greater frequency Nonetheless the Blalock Taussig operation will remain a valuable contribution because of the great stimulus it provided in the advancement of cardiovascular surgery —Ed]

Complete Anatomic Correction of Tetralogy of Fallot Defects Report of Successful Surgical Case is presented by C Walton Lillehei, Morley Cohen, Herbert E Warden and Richard L Varco[6] (Univ of Minnesota)

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(6) A M A. Arch Surg 73 526-531 September 1956

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was given digitalis and prepared for surgery The defects were corrected by closure of the ventricular septal defect and resection of the infundibular stenosis under direct vision utilizing controlled cross circulation The patient's father was the donor Anesthesia was induced with cyclopropane, thiopental and nitrous oxide The chest was entered through an anterior bilateral thoracotomy in the 4th interspace Opening the pericardium revealed a heart dusky in color due to arterial desaturation The aorta was large and the pulmonary artery small, but adequate Tapes were placed around the superior and inferior venae cavae and aorta The patient was heparinized and the ascending aorta cannulated with a thin-walled plastic catheter inserted retrograde through the right subclavian artery The superior and inferior vena cavae were cannulated via the transauricular insertion of plastic catheters Simultaneously, the donor's superficial femoral artery and saphenous vein were cannulated by similar catheters after heparinization

The pump was calibrated to deliver 200 cc arterial blood/minute from the donor to the patient's aortic catheter and to return from the patient's venae cavae to the donor's saphenous vein the same amount of venous blood for oxygenation The right ventricle was opened by a vertical cardiotomy through the length of its anterior wall after the vessels to the heart were occluded A ventricular septal defect 25 mm in diameter, located high in the septum and a high infundibular stenosis located 5 mm below the pulmonic valve had an outflow orifice only 3 mm in diameter The ventricular septal defect was closed by tying 5 interrupted 000 silk stitches placed between its opposing margins The infundibular muscle obstructing the right ventricular outflow tract was resected generously The cardiotomy incision was then closed The entire intracardial part of the surgery took 6½ minutes All catheters were removed and the chest closed

The postoperative course was uneventful When last seen 9 months after surgery the patient was normally active, the heart had decreased in size and he was no longer cyanotic or dyspneic Improvement has continued

► [This report along with others included here by Dr Lillehei and his associates at the University of Minnesota deserves special commendation Their experimental and clinical investigations demonstrating the practical application of direct vision repair of intracardiac lesions using temporary cardiopulmonary bypass methods constitute a truly valuable contribution and open a new era in cardiac surgery —Ed]

Surgical-Pathologic Classification for Isolated Ventricular Septal Defects and for Those in Fallot's Tetralogy Based on Observations Made on 120 Patients during Repair under Direct Vision Herbert E Warden Richard A DeWall Morley Cohen, Richard L Varco and C Walton Lillehei[7] (Univ of

(7) J Thorac Surg 33 21 44 January 1957

Minnesota) found that among 144 patients with intracardiac lesions who underwent direct-vision repair, the most common congenital defect encountered was an isolated ventricular septal defect (87 patients). Next in frequency was the tetralogy of Fallot (33) and atrioventricularis communis (9). All patients had recurring illness, and periodically needed pediatric or medical care. No patient was asymptomatic.

The authors suggest the following classification of ven-





Fig 24.—Methods of closing ventricular septal defects Silk (3 0) with a double armed swedged-on needle used in all instances (Courtesy of Warden, H E, *et al* J. Thoracic Surg 33 21 44, January, 1957)

tricular septal defects: (1) complete absence of ventricular septum (single ventricle), (2) defect in the posterior ventricular septum, (3) defect in the anterior ventricular septum, (4) defects in unusual positions (including muscular defects), (5) defect in anomalous septum and (6) acquired ventricular septal defects. The most common anomaly (71 patients) in this series was a defect in the posterior part of the anterior septum with normal position of the arterial trunks (membranous type). The higher incidence of membranous over other forms of ventricular septal defects indicates that these

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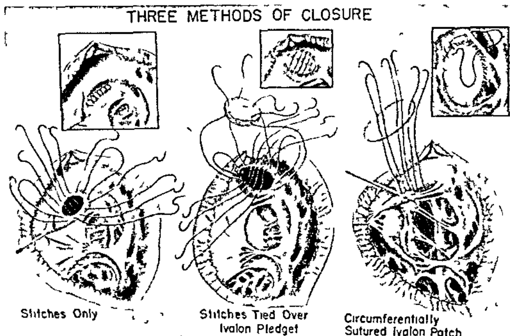


Fig 24 —Methods of closing ventricular septal defects Silk (3 0) with a double armed swedged-on needle used in all instances (Courtesy of Warden, H E, *et al* J. Thoracic Surg 33 21 44, January, 1957)

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lesions are invariably detrimental to the patient. Undoubtedly, from their location a strong pulsatile thrust is imparted to the pulmonary artery, and hence severe proliferative changes frequently develop in the arterioles of this vascular bed at an early age.

The authors found direct suture, Ivalon pledget and circumferential patch (Fig. 24) useful for repair. The particular anatomic configuration found when the heart is opened decides the choice. Pulmonary valvulotomy and/or infundibulectomy has been satisfactory for many of these patients operated on, but an important technical innovation is the use of a teardrop-shaped piece of compressed Ivalon sutured into the upper portion of the right ventriculotomy to enlarge further this outflow tract in the severe tetrads in whch it is anatomically impossible to excise sufficient muscle to accomplish this goal. Although there is some correlation between size of the defect and degree of clinical disability in patients with isolated ventricular defects, another important factor is the precise anatomic relation of the defect to the orifice of the pulmonary artery.

Studies in Extracorporeal Circulation: II. Method for Recovery and Use of Blood from Open Heart during Extracorporeal Circulation in Man. David E. Donald, Harry G Harshbarger and John W. Kirklin[8] (Mayo Clinic and

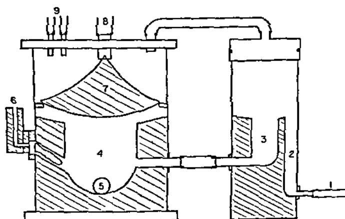


Fig 25—Extracorporeal heart lung apparatus, venous and coronary sinus reservoirs 1, outflow from coronary sinus pump, 2, antifoam column; 3, coronary sinus [illegible] venous reservoir, 6, level sensing device, [illegible] supply and pressure-sensing line to [illegible] D E, *et al*: Ann Surg 144 223 227,

(8) Ann Surg 144 223 227, August, 1956

Found.) observe that the abnormally profuse bronchial and extracardiac collateral circulation that fills the opened heart with blood during surgery must be removed to obtain a clear field for accurate operation in the heart and to restore the blood to general circulation. The system used in collecting the intracardiac blood consists of a sucker, pump and coro-

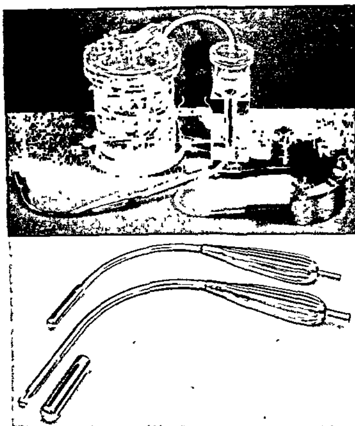


Fig. 26 (top).—Coronary sinus system. Units are separated from pump oxygenator to show connections clearly.

Fig. 27 (bottom).—Aspirators used with coronary sinus system, showing outer guard removed from inner tube of larger aspirator. Smaller aspirator is used for infants and young children.

(Courtesy of Donald, D. E., *et al.*: Ann. Surg. 144:223-227, August, 1956.)

nary sinus reservoir, including a small defoaming chamber (Figs. 25 and 26). The aspirator consists of an outer guard and inner aspirating tube (Fig. 27). The coronary sinus reservoir is made from Lucite and contains an antifoam chamber through which blood must pass before flowing into the coronary sinus reservoir chamber proper.

The combination of a low-vacuum system and a slow-running, nonocclusive pump moves the mixed columns of

which blood is to be aspirated The speed of the coronary sinus pump is under manual control and is adjusted by the operator of the pump oxygenator according to observations of blood flow through the input line to the pump With the coronary sinus system used in this manner, samples taken from the coronary sinus flow line during total bypass in man have consistently shown less than 40 mg. free hemoglobin/100 ml plasma

Total Cardiac Bypass in Humans Utilizing Pump and Heterologous Lung Oxygenator (Dog Lungs). Gilbert S. Campbell, Norman W Crisp and E B Brown, Jr[9] (Univ of Minnesota) report an effective, safe and reliable means for cardiorespiratory maintenance during intracardiac surgery The method does not cause air emboli, hemorrhages or allergic phenomena It includes dextran perfusion to remove the heparinized dog blood, open and noncannulated pulmonary veins, depulsated pulmonary vein and care as to ventilation of the isolated heterologous lung The method has been used in 7 patients subjected to intracardiac surgery and has worked well

METHOD —Heart and lungs are removed from a heparinized dog and the main pulmonary artery is perfused with 6% dextran through a plastic cannula (Fig 29) The pulmonary veins are not cannulated and back pressure on the pulmonary vascular bed cannot develop The trachea is cannulated with a large cannula and partially inflated to prevent atelectasis The lungs are ventilated with air at an intermittent positive pressure of 12-19 cm water while 1,500-2,000 cc of 6% dextran is perfused through the dog's lungs at a monitored pulmonary artery pressure The lungs must be completely free of dog's blood

The extracorporeal circuit is then set up The lungs are placed in a methyl methacrylate chamber and a depulsator, filter and strain gauge are placed between the lung pump and the lung The extracorporeal circuit is filled with warm, fresh, heparinized blood on the accessory venous pickup limb of the circuit The lung tubing is coupled to the pulmonary artery of the heterologous lungs The patient pump is set in motion and blood is forced through the circuit The heterologous lungs are ventilated with 100% oxygen at an intermittent positive pressure of 12-18 cm water at a rate of 12-14/minute Two separate thin-walled plastic catheters (12-16 F.) are inserted through separate stab wounds in the right atrium and are positioned in the superior and inferior venae cavae They are held with purse string sutures in the right auricular wall and are con-

(9) Surgery 40 364 371, August 1956

air and blood into the defoaming chamber with little or no foaming in transit. The negative pressure in the coronary sinus and main venous reservoirs seldom exceeds 5 mm. Hg While the pump is the prime mover in propelling the blood from the heart to the reservoir, the negative pressure is complementary to the nonocclusive pump and is particularly useful in maintaining constant priming of the pump. Once

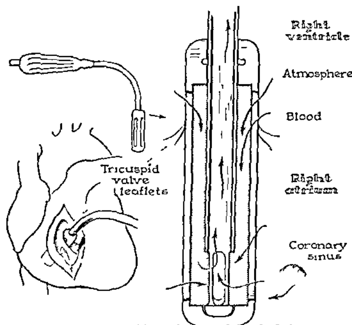


Fig 28—Proper positioning of coronary sinus aspirator as used in right ventriculotomy Note various routes blood and air may take in arriving at point of suction (Courtesy of Donald, D E, *et al* Ann Surg 144 223 227, August, 1956)

the blood seal is established in the pump, the mixture of blood and air from the heart can be admitted to the reservoir without interfering with the delicate control of the small negative pressure that prevails in the reservoir (Fig. 28). Since the coronary sinus and the main venous reservoirs are connected through blood and atmospheric phases, the same level of blood obtains in both, and blood picked up from the open heart by the coronary sinus system is admitted without delay to the main venous reservoir and thus to the general circulation

The system works best when the sucker head is placed in the most dependent portion of the cardiac chamber from

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(9) Surgery 40:364-371, August, 1956.

nected via a Y tube to the pickup limb of the extracorporeal circuit. The patient's subclavian artery is cannulated with a catheter of similar size which is attached to the outflow limb of the extracorporeal circuit.

For bypass of the patient's heart, the isolated lung is inflated with 100% oxygen under controlled pressure, and the respirator controls set at the desired level. The lung and patient pumps are turned on simultaneously and once the desired flow and balance of flow are

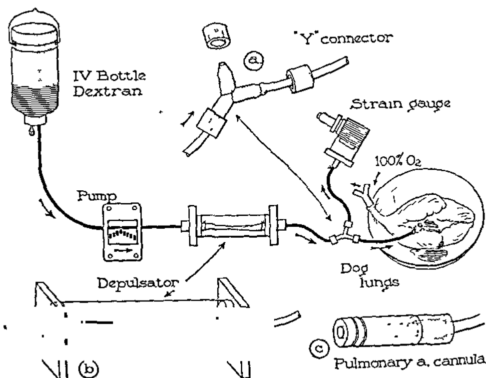


Fig 29.—Technic for perfusion of dextran through pump and depulsator into isolated dog lungs (Courtesy of Campbell, G. S, *et al*: Surgery 40 364-371, August, 1956)

obtained, the venae cavae are occluded and total cardiac bypass begun. No attempt is made to utilize the blood (usually 600-1,000 cc.) aspirated from the heart during the cardiotomy. Banked blood replaces the patient's lost blood.

►[*This method of oxygenation of blood, like controlled cross-circulation, employing a biologic oxygenator has been replaced by completely mechanical oxygenators which are more efficient and practical.*—Ed.]

Technic of Heart-Lung Bypass with Pump Oxygenator: Physiologic Studies. John Osborn, Frank Gerbode, Herbert Perkins and Raymond Hurt[1] (Stanford Univ.) performed

(1) Am J Surg 92 287-291, August, 1956

heart-lung bypass in 150 dogs and 1 human. The pump oxygenator used consists of two air-driven glass blood pumps especially designed for minimal turbulence and an artificial oxygenator composed of a battery of fluted glass plates over which blood passes in a thin film. No foam is present anywhere in the circuit. The volume of blood in the machine is held constant by a gravity-leveling system which does not require electronic controls. About 1-1.5 L. blood is needed to prime the apparatus. Oxygen is warmed and humidified before it enters the mechanical lung, and 5% carbon dioxide is added. Blood temperature is maintained by a warming jacket over part of the circuit. Maximum flow is about 2.5 L./minute at a pressure of up to 300 mm. Hg at the pump.

The dogs were heparinized and 2 soft plastic cannulas of about ¼ in. diameter were introduced through purse-string sutures in the right atrium, so that their tips lay well within the inferior and superior venae cavae. The largest possible whistle-tipped catheter was placed in the right or left subclavian artery. The cannulas were clamped and their outlets allowed to drain into the venous reservoir of the apparatus. Another catheter was threaded through the azygos vein into the right atrium to collect most of the coronary return. The apparatus was filled with donor blood, the pumps were started and perfusion slowly begun. The 2 caval catheters were then opened, but the tapes around them not tightened until the blood flowed freely from the catheters to the machine; they were then cautiously taken up, 1 at a time, during 1 minute. Finally, the azygos catheter was opened so that *all venous return was diverted from the heart to the machine.* Operations were then performed in the opened heart. Air embolism during closure of the ventricle was prevented by allowing it to fill completely with coronary blood before tying the final suture. As soon as the ventricle was closed, total bypass was discontinued, but sudden changes were avoided. First, one of the vena cava tapes was slowly released; the other 1 minute later. This prevented the blood, which was lying stagnant in the lungs and had become alkaline, from being pumped suddenly through the heart into the coronary vessels and perhaps initiating ventricular fibrillation. The heparin was then neutralized with protamine.

greater than normally achieved in a single passage through the lung may be obtained

About 90% of cases in which these methods were used were ventricular septal defects and the tetralogy lesion In the tetralogy group, 6 of 8 infants survived All are thriving and appear cured, including 1 child with complete atresia of the root of the pulmonary artery Older children and young adults were less tolerant of corrective surgery, and there were a number of inexplicable deaths The defect in the ventricular septum in the tetralogy group is regularly rimmed with muscle throughout a longer segment of its circumference than is the comparatively high defect encountered without associated valvular of infundibular obstruction Moreover, it often located behind the shelf of the hypertrophied crista supraventricularis The surgeon works, as it were, at closing a hole under a dashboard The difficulties in acquiring a working knowledge of countless features unique in a specific lesion apply almost as emphatically to ventricular septal defects For example, one peculiarity of such lesions lies in the extent of the septum that may be missing and the possible great variance in the location of the defect(s) If the hole is anywhere below the membranous area, it may be awkward to visualize because of its partial concealment behind trabeculae, hypertrophied papillary muscles and moderator bands Multiple ostia with perforations traversing the septum are not uncommon, and unless these openings are each completely exposed by appropriate division of the overlying tissues, the surgeon is likely to fail to close all stomas

Severe pulmonary hypertension is another major factor determining the mortality rate in patients operated on for ventricular septal defects With minimal hypertension surgical risk is low and pulmonary arteriolar changes minimal However, when the intramural pulmonary artery tension has risen to a balanced state with the systemic pressure the percentage of postoperative deaths is higher For patients that survive, the curability percentage, in terms of ultimate restoration of a normal pulmonary blood pressure, is lower If the pulmonary systolic arterial pressure is no greater than 70% of the systemic value, surgical risk is slight For 23 consecutive children older than 1 year, the death rate was

87% In a group of patients the same general age, but in which pulmonary artery systolic pressures were greater than 70% of the systemic value, the death rate was 38%

Use of "Arterialized Venous" Blood from Reservoir for Short Periods of Open Heart Surgery in Preference to Hypothermia The main indication for hypothermia in heart surgery has been open closure of atrial septal defects and direct incision of the fused valvular dome in cases of isolated pulmonary valvular stenosis However, good results can be obtained in many cases by closed operations at normal temperature Viking Olov Bjork[3] (Stockholm) used open surgery in a patient with atrial septal defect and in one with isolated pulmonary valvular stenosis In both operations, arterialized venous blood from a reservoir was used in preference to hypothermia

Girl, 8, had a 2 5 cm atrial septal defect 0 5 cm above the atrioventricular plane according to angiocardiography She was normally developed The heart was enlarged Because the defect was close to the atrioventricular plane, 6 L arterialized venous blood was obtained A bilateral subcostal incision was made under the 4th rib and transection of the sternum performed The right subclavian artery was cannulated A plastic cannula was then introduced in the superior vena cava through the azygos vein and into the inferior vena cava through the right auricular appendange, through the incision first used for exploration The defect was considered difficult to close by a purse string suture as no septal ridge could be palpated anteriorly over the aorta and anterior part of the interventricular septum Stay sutures were placed in the atrial wall above the defect, and the atrial wall was grasped with a super-Satinsky clamp and incised Heavy linen threads encircling the two venae cavae were drawn taut around the cannula producing an inflow occlusion Both aorta and pulmonary artery were clamped by a Crafoord clamp one limb of which passed through the transverse sinus (Fig 30) Perfusion was started, 1,800 ml arterialized blood was pumped into the aorta and 1,500 ml sucked out from the two venae cavae in 4 minutes The super Satinsky clamp was removed and the atrial defect closed with isolated 00 Eticon silk sutures Saline solution was flushed into the left atrium to wash out air before the last suture was tied The inferior vena cava occlusion was released, and its blood entered the right atrium and washed out all air before the super-Satinsky clamp was reapplied on the right atrial wall being lifted up by the stay sutures The superior vena cava occlusion was released, and the Crafoord clamp around aorta and pulmonary artery was removed Perfusion was stopped, and the heart took over the

(3) Acta chir scand nav 111 285 291 1956

by the pump oxygenator unit, the right ventricle is opened widely. The ventricular septal defect is identified, and its relation to the aortic and tricuspid leaflets noted (Fig. 31). The posteroinferior area is scrutinized to determine if this is composed of a remnant of membranous septum or whether the remnant is absent, and instead the leaflets of the mitral and tricuspid valves are continuous across

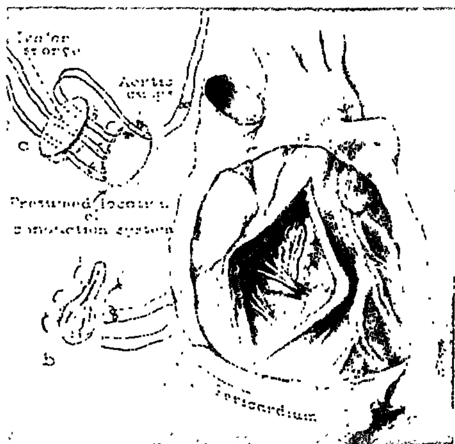


Fig. 32.—Repair of ventricular septal defect using noncompressed polyvinyl-formal sponge (*a-c*). In *a*, note proximity of aortic cusps to stitches, misplaced deep stitches in this area may tear aortic cusp Area probably occupied by conduction system should be avoided in stitching. (Courtesy of Kirklin, J. W., *et al* J Thoracic Surg. 33:45-59, January, 1957)

this area. Proposed placement of stitches is considered to avoid placing them directly posterior in a position which seems to invite conduction disturbances. Should ventricular asystole or heart block occur as a stitch is being placed, this stitch should be removed and not tied down.

On occasion, chordae tendineae attaching to the papillary muscle of the conus partly overlie these defects. In such instances, they are retracted. Mattress sutures of 00 silk are then placed for repair so

that they grasp one side of the defect, pass through an appropriately trimmed piece of noncompressed polyvinyl-formal (Ivalon) sponge and then through the other edge of the defect (Fig 32) As the mattress stitches are tied down, they bring the edges of the defect together against the interposed sponge to obtain secure closure. The line of closure is parallel to the direction of outflow from the right ventricle, but is at right angles to the direction of outflow from the left This minimizes opportunity for distortion of aortic valve leaflets

Sometimes, placement of these sutures in the inferior aspect of the right edge of the defect, as viewed from the right ventricular side, is difficult This area may be formed by the tricuspid valve ring itself and be partially overhung by the septal leaflet of this valve The most inferior pair of mattress sutures, in such instances, may be inserted into this margin of the defect through the tricuspid ring, penetrating it from the right atrial side These sutures then go through the sponge and left edge of the defect to be tied down If the defect lies completely beneath the septal leaflet of the tricuspid valve, it is often best to place all the mattress sutures in the right margin of the defect by suturing through the tricuspid valve ring (which forms this margin in such defects)

After the mattress sutures have been tied down, the repair is carefully scrutinized for residual tiny defects If present, these must be securely closed by additional stitches After the obvious large defect is closed, the septum should also be examined for smaller defects elsewhere Bronchial blood coming to the left side of the heart tends to appear through these small additional defects after the large one has been blocked Such defects are closed by direct suture

The noncompressed polyvinyl-formal sponge works well The technic must be slightly altered for other types of "high" ventricular septal defects, although the basic principles are the same Recently, the authors used potassium-induced cardiac asystole routinely in repair of ventricular septal defects Details of actual closure with this technic differ somewhat from those described

► [Dr Kirklin and his able associates deserve high praise for their contribution to open cardiac surgery through improvement and successful clinical use of Gibbon's basic pump oxygenator system In this connection, the opportunity is here provided to express high commendation also to Dr John Gibbon [illegible]
toward the devel [illegible]
his far reaching [illegible]
one of the most [illegible]

Retrograde Perfusion of Coronary Sinus for Direct Vision Aortic Surgery was studied by Vincent L Gott, Juan L Gonzales, Mohamed Nazih Zuhdi, Richard L Varco and

C Walton Lillehei (Univ of Minnesota) Retrograde perfusion, via the coronary sinus, of oxygenated blood in combination with a pump oxygenator permits work on the open ascending aorta or coronary arteries for up to 20 minutes in the dog Flow studies of the coronary sinus venous drainage demonstrated in most instances, a higher coronary flow in the bypassed heart though the perfusion pressure in the aorta remained lower than for the nonbypassed heart

In 15 acute experiments, the distribution (chamberwise) of the retrograde perfusate was studied Coronary arteriovenous differences were determined for oxygen, glucose and lactate Twenty dogs were perfused in a survival experiment Their hearts tolerated well 15 20 minutes of retrograde perfusion if the pressure head was adjusted properly

The method of back perfusion via the coronary sinus was tested in 7 patients In all, the method apparently protected the myocardium against anoxia and coronary air embolism and permitted direct vision reparative surgery for aortic stenosis and regurgitation ruptured sinus of Valsalva, aortic pulmonary septal defect and complete transposition of the great vessels The heart responded well to this altered environment for up to 15 minutes

► [Some doubt exists regarding the actual need for and usefulness of retrograde coronary sinus perfusion for aortic surgery The method is not without hazard and our experience indicates that it is unnecessary in operations on humans —Ed]

Self-contained, Disposable Oxygenator of Plastic Sheet for Intracardiac Surgery Experimental Development and Clinical Application Vincent L Gott Richard A DeWall Matthias Paneth, M Nazih Zuhdi, William Weirich, Richard L Varco and C Walton Lillehei[6] (Univ of Minnesota) describe a complete, self contained ready to use sterile bubble oxygenator constructed of 2 sheets of Polyvinyl plastic The desired chambers and channels are delineated by a heat seal of the plastic material

This latest model has resulted from research, evaluation and development applied to several different designs and will soon be available commercially Fundamentally the ... ator differs in but one feature from the oxygen

[6] Gynec 104 319 328 March 195
12 1957

sion for 1 hour with the latest model oxygenator were as follows arterial oxygen saturation, 96%, final arterial pH, 7 48, bicarbonate deficit, 8 20 mM/L, plasma hemoglobin elevation, 77 mg/100 ml and platelet count drop, 60% Thirteen of the dogs were long term survivors Most dogs were alert and walking within 4 hours after perfusion, none showed neurologic signs of embolism or cerebral anoxia Only 1 had excessive bleeding, and this appeared attributable to careless hemostasis

The sheet oxygenator was used with the Sigmamotor pump for reparative intracardiac surgery in 3 patients with ventricular septal defects and pulmonary hypertension The arterial saturation was 98-100% Two of the patients are living and well Autopsy on an infant who died 24 hours after operation with severe respiratory distress showed that the ventricular septal defect had been completely and accurately closed and the fatal outcome could not be attributed to the oxygenator Microscopic studies revealed widespread severe pulmonary arteriolar intimal proliferation

Experimental Aortic Valve, Edward P Ryan, George Johnson, Jr, and John M Beal[7] (New York Hosp-Cornell Med Center) conducted experiments in dogs, attempting to produce an aortic valve by creation of a flutter valve in the thoracic aorta

METHOD —The left thoracic cage was opened and the aorta mobilized from the left subclavian artery to the diaphragm The adventitial covering of the aorta was dissected from a segment about 5 cm long and Blalock clamps used to occlude the aorta just below the subclavian artery and above the third pair of intercostal vessels The aorta was occluded up to 55 minutes without apparent damage Intercostal arterial tributaries were controlled by bulldog clamps and the fourth pair of intercostal arteries was divided and ligated The aorta was transected and the proximal portion bivalved Incision along the wall of the aorta was measured to equal the diameter of the vessel The upper bivalved end was inserted into the lumen of the open distal end and was secured with 4 0 lubricated arterial silk sutures Occluding clamps were slowly released and the chest closed without drainage After recovery for 4-7 days, left thoracotomy was again performed Pressures in the aorta, proximal and distal to the valve, were recorded In 6 animals, the posterior cusp of the cardiac aortic valve was avulsed by a hooked knife through a left ventriculotomy In these animals, pressure recordings were

(7) Proc Soc Exper Biol & Med 94 372 374 February, 1957

repeated in the same locations following avulsion of the aortic valve. The chest was closed. In 2 animals, angiocardiography was performed after creation of the thoracic aortic valve.

In the 6 animals in which the aortic valve was avulsed, satisfactory diastolic pressure was maintained distal to the valve. Elevation of the systolic pressure was not found proximal to the thoracic aortic valve. In each of the 6 animals, a marked fall in aortic diastolic pressure was obtained proximal to the valve. In both animals in which angiocardiograms were obtained, narrowing at the site of the valve was noted.

► [The creation or placement of a competent valve in the descending thoracic aorta for the treatment of aortic valvular insufficiency is of dubious value since the arterial bed proximal to this level continues to reflux a considerable part of the cardiac output. As a consequence of this inadequate correction of the hemodynamic disturbances, it does not provide sufficient relief of the burden on the heart. Experience with the Hufnagel valve and the unimpressive results which have followed its use support this observation. It seems safe to predict that this approach to the problem will not be fruitful. For these reasons, too, the approach devised by Roe and his associates in the following article is much more appealing.—Ed.]

Technic for Insertion of Flexible Aortic Valve Prosthesis into Ascending Aorta: Experimental Study. Partial control of regurgitation through an incompetent aortic valve has been accomplished experimentally and clinically with Hufnagel's rigid, plastic, ball-valve prosthesis. This device is placed in the descending thoracic aorta distal to the carotid and subclavian vessels, which continue to reflux 30-40% of the cardiac output. Benson B. Roe, John S. Najarian and David Moore[8] (Univ. of California) developed a flexible, intraluminal, plastic valve prosthesis and a technic for placing it in the proximal ascending aorta without toal interruption of cardiac outflow. The maneuver was successful in a series of experimental animals at normal body temperature with uncomplicated immediate survival.

Technic.—The valve is a molded, tapered, plastic cylinder with a fitted outside diameter equal to or slightly larger than that of the ascending aorta (Fig. 34). The flared proximal end contains three thin-walled, pliable, shallow cusps fashioned after those of the normal aortic valve. The walls of the tube are 1/16 in. thick with an added outer ring for suturing and a tapered distal flange to avoid shelving. The cusps are tapered in thickness from 0.012 in. at the peripheral attachment to 0.008 in. at the lip. The tube is pliable enough to fold on itself for insertion, but elastic enough to snap back into the open position against resistance. Valves presently

(8) Ann Surg. 145 388-391, March, 1957.

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TECHNIC —The valve is a molded, tapered plastic cylinder with a fitted outside diameter equal to or slightly larger than that of the ascending aorta (Fig 34) The flared proximal end contains three thin walled, pliable shallow cusps fashioned after those of the normal aortic valve The walls of the tube are 1/16 in thick with an added outer ring for suturing and a tapered distal flange to avoid shelving The cusps are tapered in thickness from 0 012 in at the peripheral attachment to 0 008 in at the lip The tube is pliable enough to fold on itself for insertion, but elastic enough to snap back into the open position against resistance Valves presently

(8) Ann Surg 145 388 391 March 1957

used are made of a new polyvinyl chloride plastic with a polymeric plasticizer. This material appears nonreactive and gives excellent promise of retaining its flexibility. Resistance to flow of the valve in a fluid system is minimal. Competence of the valve cusps is nearly perfect, and it withstands pressures up to 350 mm. Hg without significant leak. At 150 mm Hg and a flow rate of 4 L./minute, the pressure drop across the valve is 12 mm. Hg.

The valve is passed with a suture of 00 chromic catgut through

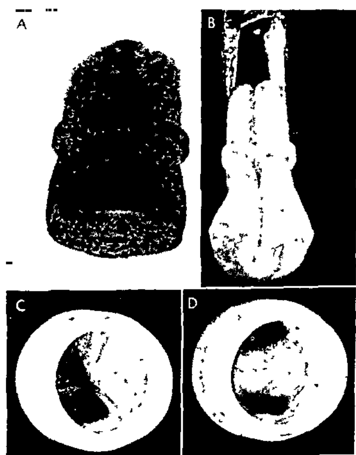


Fig 34 —Polyvinyl plastic valve prosthesis *A*, note ring for anchoring sutures, *B*, valve folded in clamp for insertion in aortotomy, *C*, inside view of closed valve cusps, *D*, cusps retracted (Courtesy of Roe, B B, *et al* Ann Surg 145 388 391, March, 1957)

the ascending aorta and looped distally by pushing the semi-rigid suture through the aortic wall The loop is drawn out through an incision in the distal thoracic aorta which has been occluded above and below after advancing the loop. The folded valve is then sutured to the catgut loop, inserted into the aorta and drawn proximally by traction on the catgut suture with momentary release of the proximal aortic occlusion with the operator's finger over the aortotomy.

The aortotomy is then closed with continuous arterial silk suture and the occlusion is released. This maneuver can be accomplished with less than 7 minutes of aortic occlusion. The prosthetic valve is then secured in the ascending aorta with horizontal mattress sutures of 4-0 braided silk through the aortic wall into the ring. The catgut "fishing" suture is then withdrawn, and when necessary, the suture holes are closed with 5-0 arterial silk.

Aortic Valvulotomy under Direct Vision during Hypothermia was performed by F. John Lewis, Normal E. Shumway, Suad A. Niazi and Robert B. Benjamin[9] in 3 patients, 2 of whom did well and 1 died as a result of a technical error.

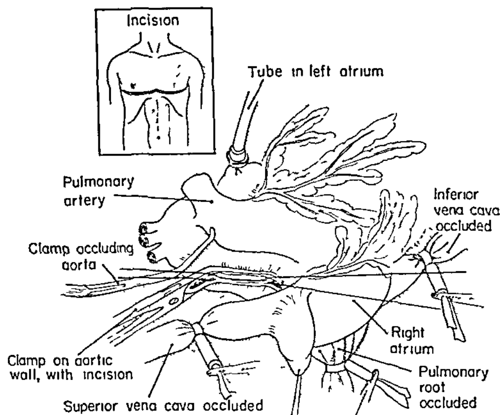


Fig 35 —Completed preparations for entry of aorta by opening the Beck clamp *Inset*, position of chest incision (Courtesy of Lewis, F. J, *et al* J Thoracic Surg 32 481 499, October, 1956)

TECHNIC —The patient is anesthetized with Pentothal® and a curarelike drug, and the intratracheal tube is attached to an automatic respirator. Refrigerating blankets are used to bring body temperature down to 28-29 C. The chest is opened by a transverse incision through the 3d interspace. Tapes are placed around the

(9) J Thoracic Surg 32 481 499, October, 1956

lung roots and around both venae cavae A small catheter is placed into the left atrium through the atrial opening to wash air out of the left heart at the end of the operation The tissues around the base of the aorta are infiltrated with procaine, the ascending aorta is cleared and the right coronary artery is exposed Distally, the ascending aorta is freed from the pulmonary artery Fine stay sutures are placed in the ascending aorta to mark each end of the aortotomy, and a Beck clamp is closed beneath the stay sutures to separate a generous lip of the ascending aorta The aortotomy incision is made in the lip of the aorta held by the Beck clamp (Fig 35)

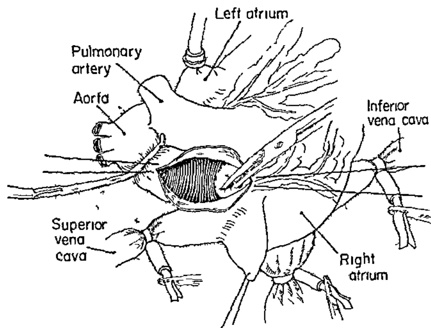


Fig 36—Open aorta exposes stenosed aortic valve, fused cusps are separated with scissors (Courtesy of Lewis F J et al J Thoracic Surg 32 481 499 October 1956)

Both venae cavae are occluded the respirator is turned off and the loops around both pulmonary roots are tightened to occlude the pulmonary veins A Satinsky clamp is used to occlude the ascending aorta just proximal to the innominate artery, then the aorta is opened by removing the Beck clamp The aortic valve is exposed by sucking the blood out of the aorta (Fig 36) Each commissure is opened to the aortic wall with a knife and heavy Mayo scissors After the commissures are opened satisfactorily, a finger is passed into the left ventricle to check the size of the orifice

The aorta must be closed without leaving air in the left heart To do this, the venae cavae and pulmonary roots are released The fine sutures at either end of the aortic wound are elevated and the Beck clamp is placed behind them, ready to close the wound As

this is done, saline solution is injected under pressure through the catheter in the left atrium, and a small metal tube is passed down through the aortotomy, the aortic valve and into the left ventricle, to inject more saline solution into the air-filled left heart As soon as 3 or 4 satisfactory heart beats have pumped out some air-free fluid, the aortic incision is closed and the distal aortic clamp released The respirator is restarted The chest then is closed and the patient rewarmed by pumping warm solution through the blankets around the patient

Surgical Treatment for Aneurysms of Aortic Sinuses with Aorticoatrial Fistula: Experimental and Clinical Study by John L Sawyers, Jesse E Adams and H William Scott, Jr[1] (Vanderbilt Univ) was prompted by observation of a case in a surgeon, aged 32 Diagnosis of this rare lesion was based on the history of an episode of acute dyspnea followed by development of a heart murmur and on cardiac catheterizations showing a large left-to right shunt at the right atrium A review of 47 reported cases showed that at the time of intracardiac rupture of the aneurysm there was usually sudden onset of substernal or upper abdominal pain or of extreme dyspnea and palpitation If the patient survived the immediate episode, an almost symptomless phase of variable duration followed Then aortic and tricuspid insufficiency developed with a characteristic loud harsh murmur (present in 94%) Death usually resulted from sudden congestive heart failure or bacterial endocarditis The mean survival was 3 9 years, but by exclusion of 2 patients who lived 10 and 15 years, the average life expectancy was nearer 1 year

TECHNIC —Fistulas between the noncoronary sinus of Valsalva and the right atrial cavity were produced in dogs by a 2-stage procedure Seven dogs with induced defects survived with patent fistulas for several weeks and had the aorticoatrial shunt closed at a third operation Hypothermia (26 28 C) was induced and the thorax opened widely by bilateral anterior intercostal thoracotomy with transection of the sternum at the level of the 3d intercostal space The venae cavae were encircled with tapes, the pericardium was opened wide, and the ascending aorta dissected free from the pulmonary artery A diverticulum was sutured to the ascending aorta (Fig 37), permitting the operator's finger tip to be inserted into the aortic sinus at the fistula site The venae cavae were then occluded and the right atrium opened The finger tip tampo nades aortic blood flow through the fistula and protects the aortic valve leaflet from incorporation in sutures during closure Inter-

(1) Surgery 41 26 39 January 1957

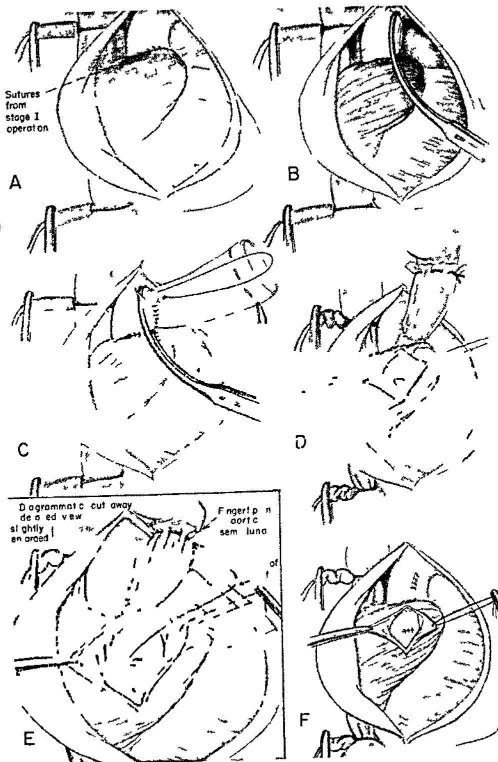


Fig 37 Ste s in repa r of experimental aort coatr al fistula us ng hypotherm a and inflow stas s (Courtes of Sawyers J L *et al* Surgery 41 26 40 January 1957)

rupted sutures were placed transversely to close the fistula, carefully including the aortic wall as well as atrial wall in each stitch The finger-tip was then withdrawn from the diverticulum whose extremity was occluded The superior caval occlusion was quickly released and as air was displaced from the filling atrium, the edges of the atrial incision were elevated by stay sutures, grasped in a clamp and closed by sutures while inferior caval occlusion was gradually released The total period of stasis was 5 8 minutes The diverticulum was removed after a clamp was reapplied tangentially to isolate the aortic incision, which was then closed by sutures Pericardial and thoracotomy incisions were closed and rewarming was begun The dogs survived this operation 3 or more months before being killed, and autopsy showed complete closure of the fistula in each instance with no damage to the aortic leaflet

Despite the poor initial survival results in preliminary efforts to produce and close aorticoatrial fistula in dogs by a pump oxygenator and induced cardiac arrest, this method has a distinct advantage of eliminating the need for extreme haste (the chief drawback of the foregoing procedure) and deserves further evaluation in the development of a satis factory method for repair of aorticoatrial fistula

Mitral Commissurotomy in Younger Age Group P F Angelino V Levi, A Brusca and A Actis Dato[2] (Turin, Italy) present the results with mitral commissurotomy in 11 patients, 6 boys and 5 girls, aged 8 16 The condition of all gradually deteriorated before admission, despite cardiac therapy

Clinical and radiologic signs of pulmonary congestion were seen in all Clinical or laboratory data suggestive of an active rheumatic process were absent According to the standard of the New York Heart Association, 1 patient belonged to functional class II 5 to class III and 5 to class IV

At surgery, pure mitral stenosis was found in 10 patients and 1 had an associated mild mitral insufficiency The size of the mitral valvular orifice was small in all but 1 In none was a surgically produced mitral insufficiency observed

No deaths occurred The postoperative course of these children did not differ significantly from that usually observed in adults with mitral stenosis The results were good in all patients No reactivation of rheumatic fever was observed up to 20 months after surgery, probably because antirheu

(2) Am. Heart J 51 916-925 June 1956

matic drugs (cortisone, ACTH and aspirin) were given and antistreptococcic prophylaxis was carried out pre- and postoperatively

Current Indications for Surgical Correction of Mitral Stenosis *Indications for valvuloplasty for mitral stenosis as* proposed by Harrison Black and Dwight E Harken[3] (Harvard Med School), are based on the following clinical classification group 1, murmur without symptoms, group 2 murmur plus static symptoms, group 3, murmur plus progressive symptoms with evidence of right ventricular failure that responds to therapy, and group 4, murmur, progressive symptoms and irreversible congestive failure Group 3 patients gain the most from surgery with the least risk, currently, the mortality in this group is less than 1% The rate in group 4 is 20 25%

A 3 year follow up on 500 valvuloplasty patients revealed that 89% of the combined groups 2 and 3 are improved, and 56% are leading essentially normal lives Similar scrutiny of a second 500 patients promises even better results

Love and Levine reported on 164 patients with mitral stenosis followed in a cardiac clinic, 13% survived 9 or more years after the first signs of congestive failure or auricular fibrillation Thus, medical management carried an 87% mortality However, results should not be judged only by the mortality rate, but also by the poor clinical state before death

At present, the following factors strongly point to the need for surgery in a patient with pure mitral stenosis episodes of congestive failure, x ray evidence of pulmonary hypertension, ECG evidence of right ventricular hypertrophy, "strain" or right bundle-branch block, auricular fibrillation, difficulty with sexual intercourse, repeated arterial embolization and severe symptoms from mitral stenosis in pregnancy

Age, auricular fibrillation, associated moderate mitral insufficiency, calcification of the mitral valve or tricuspid stenosis do not preclude operation Florid rheumatic carditis is a contraindication to operation for mitral stenosis Other diseases, including arteriosclerotic and hypertensive cardiovascular disease undoubtedly increase the risk Persons

(3) Am Heart J 53 439 446 March 1957

with only the murmur of mitral stenosis but without symptoms should not be offered operation.

► [Although mitral commissurotomy has now become a standard procedure, these careful follow-up studies and analyses of experience by Black and Harken as well as by Janton and his associates in the following article not only establish the long-term value of the operation but also provide strong support for its advocacy during the early phases of the disease.—Ed.]

Status of 50 Patients 4½-7 Years after Mitral Commissurotomy was evaluated by O. Henry Janton, Julio C. Davila and Robert P. Glover[4] (Hahnemann Med. College). At the time of surgery, none were in class I, 5 (10%) were in class II, 36 (72%) in class III and 9 (18%) in class IV. Operative mortality was 6% (3 patients) and later mortality 12% (6 patients). The other 41 patients (82%) are living and were followed. Twenty-nine, 71% of those living or 58% of the original number, are considered to be in better condition and living a more nearly normal life than before surgery. According to the patients themselves and their family physicians, 36 consider themselves to be in better condition.

On the basis of the murmurs alone, no conclusions can be reached regarding the patients' present clinical status. However, 4 of the 41 have no murmurs, 11 no longer have their original mitral diastolic murmur and 14 have a mitral systolic murmur which was not present preoperatively. Patients with "pure" mitral stenosis obtain the best results from mitral commissurotomy.

Electrocardiographic patterns do not improve regularly after surgery, but a minority will show regression of right ventricular hypertrophy. Fluoroscopic and x-ray study showed that 10 patients have a smaller cardiac silhouette, 5 a larger one and 26 the same size as preoperatively. Thus, in 87% of the patients the heart is the same size or smaller than before surgery, whereas in the years preceding surgery it grew progressively larger.

Improvement was more striking in the patients without calcification. Valvular restenosis was not present in any. Only 1 embolus occurred during operation and the patient in whom it was seen recovered almost completely. No emboli occurred postoperatively, although the incidence before surgery was 12%.

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(4) Circulation 14 175 184, August, 1956

Commissurotomy confers a genuine, often dramatic and usually persistent benefit to the patient It is a valuable ad junct in the over all treatment of mitral stenosis

Postcommissurotomy Syndrome, consisting of chest pain fever and joint pains with evidence of pleural and pericar dial irritation was observed by Kempson Maddox and John Saxton[5] (Royal Prince Alfred Hosp Sydney) after 20 of 218 operations on the mitral valve These episodes may follow immediately or some weeks after operation Indirect evi dence suggests they represent reactivation of the rheumatic state, provoked by operation These episodes do not appear to follow other types of operation on patients with rheumatic heart disease and frequently occur many years after the last experience of acute rheumatism

A review of the literature suggests no relationship be tween the syndrome and age or sex of the patient, histologic evidences of rheumatic activity in biopsy of the auricular appendix difficulty of valvotomy, preoperative history of acute rheumatism or bacteriology of the pharynx The syn drome is almost never fatal and does not seem to influence adversely the satisfactory outcome of mitral valvotomy Symptoms and fever can be abated immediately by use of cortisone but relapse can occur on cessation of administra tion No satisfactory objective test exists to assist in fore casting this complication, although the test for C reactive protein is promising Postoperative penicillin prophylaxis was not used in the authors' patients

Surgical Treatment of Aortic Stenosis is discussed by Rus sell Brock[6] (Guy s Hosp London) Aortic stenosis is a sur gical disease, and each patient should be considered as pos sibly needing surgery Operation is most effective in the early stages before signs of chronic invalidism have ap peared Without obvious clinical signs of heart failure con siderable enlargement of the left ventricle (without regurgi tation) or deterioration in serial ECG's may indicate surgery Left ventricular puncture with a brachial artery pressure tracing may be invaluable in deciding for or against opera tion in difficult cases A high left ventricular pressure and a

(5) Australasian Ann Med 5 268 273 November 1956
(6) Brit M J 1 1019 1078 May 4 1957

high gradient indicate need for operation The gradient may be deceptively high only if significant regurgitation coexists, such substantial regurgitation should be recognizable by other methods The author performed direct left ventricular puncture in 90 patients without morbidity or mortality It was much less disturbing to the patient than left atrial puncture Angina pectoris or some aortic regurgitation is no contraindication to valvotomy Once the valve cusps are deformed by calcified deposits, the value of surgery is limited Among the author's patients, in only 1 over age 30 was the valve not calcified If aortic stenosis is associated with mitral stenosis, severe calcification is less frequent If the right- or left sided heart failure is unrelievable by routine medical treatment, the time for useful surgery has passed

For calcified aortic stenosis, Brock prefers the transventricular route, for noncalcified cases, open aortic valvotomy under direct vision and with hypothermia is used Combined aortic and mitral valvotomy was done in 34 patients with 3 deaths, due to the mitral stenosis and not to the operation Aortic valvotomy was better tolerated when combined with mitral valvotomy Among 78 patients with pure aortic stenosis who underwent surgery, there were 14 deaths due to operation (18%) However, 5 of these deaths occurred in the first 8 patients, all of whom were extremely bad risks Some degree of regurgitation was produced in 14 patients and was largely responsible for the death of 4, but preoperative regurgitation was lessened or completely relieved in several patients Regurgitation should not exclude surgery Mortality will always be high if operation is deferred until heart failure has supervened

► [Although most American surgeons have more recently advocated the transaortic route for aortic valvulotomy, it is difficult to support claim for its advantages over the transventricular route in light of the excellent results obtained by Brock using the latter approach The argument however, will probably soon become academic since as Brock himself admits aortic valvulotomy under direct vision using temporary cardiopulmonary bypass appears to be the more satisfactory method —Ed]

Experimental and Clinical Resection for Ventricular Aneurysm was studied by C P Bailey and R A Gilman[7] (Philadelphia) Ventricular aneurysms may be caused by trauma congenital deformation of the heart or myomalacia,

(7) Surg Gynec & Obst 104 539 542 May 1957

most often that due to myocardial infarction Schlicter and associates found a 20% incidence of aneurysm formation among 512 patients who had had acute coronary occlusion and had come to autopsy Actual rupture of a ventricular aneurysm is rare, death being due to other causes, such as heart failure or thromboembolic episodes

The aneurysm involves mostly the left ventricle, which will be considerably larger than normal, in part because of addition of the volume of the aneurysmal sac but largely as a manifestation of compensatory dilatation of the actual lu men of the left ventricle, which now must propel blood into both the aorta and the aneurysm In such instances, consid erable "tailoring" of the shape and size of the left ventricular chamber would seem to be tolerable if not actually beneficial, for removal of the aneurysm with its deleterious paradoxic mechanism must take away much of the physiologic neces sity for the intrinsic ventricular enlargement

The authors treated 8 patients with ventricular aneurysm by "ventriculoplasty," i e, subtotal excision of the fibrosed portion of the ventricular wall One patient died at the con clusion of the procedure because of inadvertent dislodgment of the thrombotic contents of the sac during the surgical manipulations

Surgical Management of Coronary Artery Disease Background, Rationale, Clinical Experiences According to Claude S Beck and Bernard L Brofman[8] (Cleveland), the coronary problem has two facets, i e, distribution and amount of blood available to the heart Faulty distribution kills 80 90% of victims, inadequate total flow 10 20% Normally, the coronary arteries can carry at least five times as much blood as the capillary bed receives Only when the cross sectional diameter of the large vessels is reduced to less than 25% is there significant hemodynamic impairment at rest If distribution is adequate, occlusive disease in the coro naries may go on to completion before death The crippled coronary circulation can be helped by an even distribution of the blood entering these arteries, or by addition of blood to that which enters the diseased arteries While distribution is easily accomplished by surgical production of intercoronary

(8) Ann Int Med 45 975 988 December 1956

channels, augmentation of the flow is not practical at present.

METHOD.—A ligature is passed around the coronary sinus about 1-2 cm. from its ostium in the auricle, constricting the sinus to a lumen of about 3 mm. This narrowing induces somewhat greater extraction of oxygen from the venous blood, which normally is already greatly reduced. The mild venous stasis reduces oxygen differentials in the presence of arterial occlusion, and this probably protects the heart with coronary disease. It also produces intercoronary channels. However, increased capillary pressure may reduce total coronary artery inflow. If the sinus is hard to approach at operation, as in cardiac enlargement, this step is omitted. The second step is abrasion of the lining of the parietal pericardium and the epicardial surface of the heart. This produces inflammation, with resultant intercoronary channels. About 0.3 Gm. of coarsely ground asbestos is then applied to the surface of the heart, producing mild inflammation. The mediastinal fat is then brought in contact with the heart to act as a graft upon it. Each step in operation contributes to the final result. The one hour operation itself is tolerated remarkably well.

Neither medical nor surgical treatment reduces the occlusive process in the arteries or prevents further development of arterial disease or restores degenerated myocardium. However, surgery makes blood available to muscle rendered ischemic by arterial disease. So far, the authors have not performed the operation prophylactically. Surgery would be indicated, however, in coronary insufficiency, angina pectoris and after one or more infarcts. Interval between operation and the last infarct should be at least 6 months. Operation should be delayed until the clinical course is stabilized. Surgery is contraindicated in congestive heart failure or if the heart is markedly enlarged.

Among 100 consecutive patients operated on, operative mortality was zero. One patient had a fatal coronary occlusion before discharge. The left ventricle was enlarged in 40 and normal in 60. There was no observable infarct in 22, and one or more infarcts in 78. Arterial disease was observed or palpated in 97, and was not found in 3. The term "salvage" was applied to those in whom the left ventricle was enlarged and in whom there was an area of myocardium with reduced or absent pulsation; 27 patients were classed as salvage and 73 as good candidates. Of 100 patients followed 6-60 months after operation and who could be evaluated, there was no pain in 40, less pain in 48 and a total of 88% improved. Fre-

quently the patient stated that tightness in the chest was relieved as early as the first week after operation

Left Internal Mammary Arteriocardiopexy in Therapy of Coronary Artery Insufficiency Preliminary Experimental Report is presented by Jack Litvak and Arthur M Vineberg[9] (McGill Univ) Previous studies by Vineberg and co workers indicated that the internal mammary artery can be successfully introduced and is capable of supplying arterial blood to an ischemic myocardium Experiments on dogs showed that about 75% of implanted internal mammary arteries form satisfactory communications with the coronary arterioles The success of the implantation procedure depends on the proper technic of implantation and a receptive ischemic myocardium Removal of the epicardial barrier appears to enhance adequate vascular union between proliferating branches of the transplanted vessel and those feeding blood to an ischemic myocardium An implanted internal mammary artery, which may have previously blocked due to angulation thrombosis, intimal proliferation or dubious surgical technic, can remain fully patent and functioning if allowed to remain intact as a complex loop (arteriocardiopexy) and maintained in direct apposition to the bared myocardium The new technic was tried in dogs

Technic—After the thorax was opened a 1 cm width of parietal pleural and any underlying transversus thoracis muscle was removed from the entire area overlying the left internal mammary artery from the level of the left subclavian artery to the diaphragm The internal mammary artery was then gently eased from its bed and all its branches were doubly ligated and separated The 5th, 6th and 7th intercostal branches were ligated at least 1 cm from their origin All available fat pads were separated from the anterior surface of the pericardium The freed loop of internal mammary artery fell into place over the ventricles, usually extending from the pulmonary conus to the apex of the left ventricle The epicardium was stripped along this entire path, extending over the right and left ventricles to the apex and decussating with the anterior descending ramus of the left coronary artery The long ends of the ligatures on the intercostal branches were loosely sutured to the epimyocardium on either side attaching the artery without tension to its previously determined bed on the bared myocardium The previously prepared mediastinal fat pad was pulled over the transplanted internal mammary artery and attached loosely

(9) Surgery 41 738 744 May 1957

by 3-4 sutures to the epimyocardium, about 2 cm to the left of the transplanted vessel The thorax was closed after careful reinflation of the lung

Coronary artery occlusion was produced in the dogs with a casein plastic at the time of arteriocardiopexy In studies performed up to 60 days later, histologic evidence of anastomotic communications between the transplanted artery and the myocardium was found in every specimen There was no significant evidence of angulation, thrombosis or endarteritis with intimal or medial hyperplasia in any specimen examined 60 days after arteriocardiopexy.

Implantation of Left Internal Mammary Artery in Myocardium· Histopathologic Evaluation after Six Months R Maniglia and A A Bakst[1] (Hahnemann Med College) implanted the left internal mammary artery in the myocardium of the left ventricle of dogs according to the procedure originally proposed by A M Vineberg The animals were allowed to live 6 months At the end of this period, quantitative measurements of the collateral blood flow failed to reveal an increase in collateral circulation because a constant intimal proliferation of fibroelastic tissue narrowed the lumen of the transplanted mammary artery from 50% to 10% of the normal caliber Thrombosis at some point in the course of the artery, usually in the distal half, was an added feature in 4 instances

Vascular channels, interpreted as capillaries, arterioles and small sized arteries, were noticed in the collagenous cuff surrounding the transplanted artery, but, since injection studies were not performed, it is not known whether these vascular channels represent anastomotic blood vessels

Failure of Cardiopericardiopexy to Protect Pigs against Acute Coronary Occlusion The pig heart was chosen for the experiments by Harry Gross, Allan E Bloomberg, Morton Rosenblatt, Adrian Kantrowitz, Clarence J Schein and Ruthven Ferreira[2] (Montefiore Hosp, New York) because, like the human heart, it normally has no intramyocardial anastomoses and the rapid growth in a short time makes it possible to evaluate the protective role of talc

No benefit resulted from talc cardiopericardiopexy in pro-

(1) A M A Arch Surg 73 187-191 August 1956
(2) J Thoracic Surg 33 679-684 May 1957

tecting the pig heart against subsequent ligation of the coronary arteries Pericardial adhesions developed wherever talc powder was insufflated The adhesions were dense and so avascular that, when cut, they did not bleed During the period of observation, there was no histologic or gross evidence of increased collateral circulation

The ligations were sudden, complete and high, 2 cm or less distal to the bifurcation of the left coronary artery The experimental conditions do not completely mimic the course of human coronary artery disease In man, the greatest stimulus to collateral circulation is progressive coronary narrowing and when collaterals are well developed, occlusions of one or both major coronary arteries may be well tolerated

However, in these experiments pigs surviving talc cardiopericardiopexy for as long as a year were not protected against acute occlusion of the left coronary artery

Follow-up Report on Resection of Anginal Pathway in 33 Patients Clem F Burnett Jr and James A Evans[3] (Lahey Clinic) subjected 33 patients with severe disabling angina pectoris to resection of the anginal pathway, 1st to 4th thoracic ganglions on both sides (Fig 38) Surgical mortality was 9% Of 30 patients who survived operation, 18 had complete relief from anginal pain for 1-11 years, 8 noted mild exertional discomfort but were considered to have satisfactory results, and 4 obtained no relief for periods up to 4 months

No immediate or permanent adequate relief was achieved in 8 patients, 2 of these, however, had complete relief for several months, until infarction recurred A third patient later obtained complete relief by a second more complete resection of the pathway Only one side of the pathway was resected in 2 Later, 1 of them had the other side resected, with complete relief A third had only the 1st and 2d thoracic ganglions on the left resected Regrowth of sympathetic fibers occurred in 1 An emotional overlay marked failures in 3 patients, in 2 of whom diagnosis of true angina was questionable Subsequent coronary infarction developed in 5, which was fatal to 1

Resection of the anginal pathway, although not the final answer to the problem of disabling angina pectoris offers re

(3) J A M A. 162 709 712 Oct 20 1956

lief to certain carefully selected patients. Best results have been obtained in patients with angina and hypertension, especially when the procedure is combined with extensive sympathectomy and splanchnicectomy. Patients with overalarm type of anginal pain also benefit, provided a strong emo-

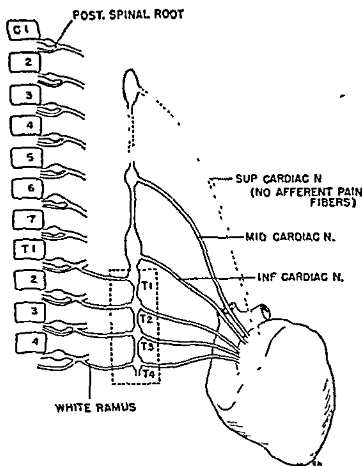


Fig 38—Cardiac afferent pain pathway showing how anginal pathway is funneled through 1st, 2d, 3d and 4th thoracic ganglions (Courtesy of Burnett, C F, Jr, and Evans, J A J A M A 162 709 712, Oct 20, 1956)

tional overlay is eliminated, admittedly a difficult calculation. This overalarm type of angina pectoris bears some resemblance to reflex sympathetic dystrophy, which may account for the higher degree of response to sympathectomy. The operation may offer great relief to patients with angina decubitus who have not had a recent coronary occlusion or a great functional overlay.

Surgical Treatment of Occlusive Coronary Artery Disease by Endarterectomy or Anastomotic Replacement Karel B Absolon, Joseph B Aust Richard L Varco and C Walton Lillehei[4] (Univ of Minnesota) performed endarterectomy of

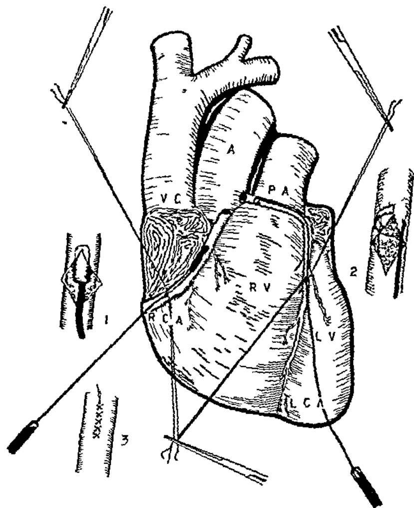


Fig 39 —Experimental coronary endarterectomy (Courtesy of K B Absolon *et al*)

small segments of 2 cadaver hearts by incising the coronary arteries longitudinally removing the occluding atheroma and reconstructing the arterial wall with a continuous 6-0 silk stitch The main coronary arteries, as well as the coronary arteries beyond the first bifurcation of either the right or the left main coronary could be approached by this method In 8 cadaver hearts a tunneling technic was used in

(4) Surg Gynec & Obst 103 180 185 August 1956

which 2 incisions 5 mm. long were made at opposite ends of the involved segment of coronary artery and the diseased sequestrum was removed with spoon-shaped and loop-shaped endarterectomy instruments (Fig. 39). Both the main artery and its branches could be treated by this method. Difficulties were encountered in 2 hearts in which calcified plaques pene-



Fig 40—Anastomosis in dog between left subclavian artery (*LSA*) and circumflex branch of left coronary artery (*LCA*), using molded synthetic vessel (Ivalon) to bridge gap (Courtesy of Absolon, K B, *et al* Surg, Gynec. & Obst. 103 180 185, August, 1956)

trated through the entire thickness of the wall. After removal of the occluding atheroma, the remaining vessel wall was often thin The segments of peripheral arteries of corresponding size were anastomosed in 2 hearts, either end-to-end or end-to-side, to the coronary arteries beyond the bifurcation.

An Ivalon prosthesis was used to anastomose the subclavian artery to the circumflex branch of the left coronary artery in 15 dogs, 2 of which are long-term survivors (Fig. 40). In 12 dogs, the internal mammary artery was anastomosed

to the circumflex branch of the left coronary artery and in 15 dogs, the left carotid artery was anastomosed to the circumflex branch of the left coronary artery Anastomosis was either end to side or end to end and in some animals was done over a polyethylene tube shunt There were few survivors Most of the deaths were due to ventricular fibrillation, which emphasizes the need for total cardiac bypass with pump oxygenation

The study indicates that both endarterectomy and anastomotic replacement are technically possible in man

► [This report and that which follows by the University of Minnesota group of surgeons demonstrating ... k on occlusive coronary artery disease off ... ach to this problem yet proposed There are ... ay prove to be clinically applicable in selected cases after the development of satisfactory methods for this purpose —Ed]

Direct Suture Anastomosis of Coronary Arteries in the Dog Examination of the heart in severe coronary arteriosclerosis shows that the disease affects more severely the proximal portions of the major coronary branches The atherosclerotic plaques are often diffusely scattered throughout the coronary system, and there are multiple points of stricture and occlusion However, less often, the disease may be localized to a relatively short segment of the major arterial trunk It is this group of cases which presents a challenge to surgical attack on the coronary vessels by endarterectomy or by suture anastomosis Alan Thal, John F Perry, Jr, Fletcher A Miller and Owen H Wangensteen[5] (Univ of Minnesota) developed the following technic for anastomosis between a major coronary artery and the internal mammary artery in the dog

TECHNIC —The pleura is incised over the subclavian artery, and this vessel and its branches are mobilized The various branches are carefully dissected out, and all but the internal mammary are divided and ligated about 1 cm distal to their origins (Fig 41 *a*) The internal mammary artery is divided at a convenient point The whole subclavian trunk is then rotated so as to approximate the internal mammary artery to the left circumflex artery under the least tension The last centimeter of the internal mammary is then carefully prepared for anastomosis by removal of adventitious tissue

While this part of the dissection is being performed, about 500 cc of arterial blood is collected from the femoral artery of a donor dog

(5) Surgery 40 1023 1029 December 1956

It is collected in a standard vacuum bottle, and coagulation is prevented by heparin. This bottle is then arranged so that blood can be delivered under controlled pressure. A glass cannula with a blown olive tip is most suitable for cannulation of the coronary artery, the curved limb being particularly useful for rotating the anastomosis.

The coronary vessels are now dissected free of the epicardial fat and the bifurcation of the left main coronary artery exposed. A 00 silk tie is placed loosely around the circumflex portion of the bi-

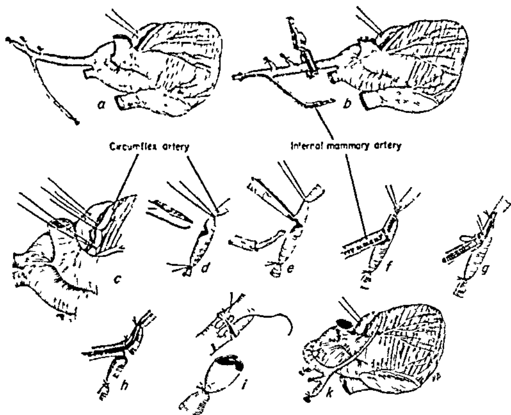


Fig 41.—Technical detail of end to end internal mammary to coronary artery anastomosis. *b*, cannula carrying oxygenated blood inserted in internal mammary artery via vertebral branch of subclavian. *k*, completed anastomosis. (Courtesy of Thal, A., *et al.*: Surgery 40:1023-1029, December, 1956.)

furcation and a rubber band ligature about 1 cm. distal to this point. The adventitious tissue is then cleaned off the coronary artery at the proposed site of anastomosis.

With the cannula connected to the source of arterial blood, preparations for anastomosis can be made. The cannula is well coated with sterile mineral oil to reduce intimal damage, and then it is inserted through the vertebral branch of the subclavian down the internal mammary artery. The vertebral branch is then securely tied around the base of the cannula. The internal mammary artery now slides freely over the tip of the cannula. The proximal tie around the

circumflex artery is secured and the anterior wall of the artery divided immediately distal to the point of ligation The olive tip of the glass cannula is then inserted into the circumflex artery and secured by tightening the elastic tourniquet proximal to the tip (Fig 41, *f* and *g*) The flow of arterial blood is then started A flow of 10 20 cc of blood/minute is sufficient to maintain normal rhythm for as long as 30 minutes Once this flow is established the anastomosis can be unhurriedly completed The anterior row of sutures is completed before the posterior wall of the circumflex artery is divided *This helps steady the vessel during insertion of the first sutures* A running everting mattress stitch of 6 0 silk is used When the posterior wall of the circumflex artery is divided, the needle is passed under the artery and the anastomosis rotated so that the posterior wall lies anteriorly This greatly aids precise placement of the sutures along the posterior wall Great care is taken throughout the anastomosis to obtain a precise intima to intima approximation using many finely placed stitches as close to the margin of the vessels as possible At completion of the anastomosis the tourniquet is released from around the glass cannula and the ligature holding the cannula in the stump of the vertebral artery divided The cannula is quickly withdrawn the stump of the vertebral artery is clamped and the bulldog clamp occluding the subclavian artery quickly removed, allowing aortic blood to resume flow into the internal mammary artery and into the left circumflex coronary artery The anastomosis is now complete, and any slight leak generally responds to gentle pressure with a sponge

In general, the anastomoses were completed in 5 10 minutes With increasing experience, the operation could be done with greater facility and precision, thereby increasing the survival rate to about 75%

The major problem in small blood vessel anastomosis has been early thrombosis and progressive stricture of the anastomosis Of 17 animals operated on in standard fashion and allowed to survive 2 6½ months patent anastomoses were found in 7

THE AORTA AND PERIPHERAL ARTERIES

Complications of Aortography Aortography is a valuable clinical diagnostic procedure The frequency and extent of its application are limited only by its risks It is relatively safe, but serious complications do occur E Stanley Crawford,

Arthur C Beall, John H Moyer and Michael E De Bakey[6] (Baylor Univ) review the complications recorded in the literature and analyze their personal experience with 300 aortograms

The complications of aortography are pain, hemorrhage, thrombosis and embolism, renal insufficiency, neurologic changes, allergic reactions and other systemic disturbances perhaps related to the use of general anesthesia Complications are infrequent, but their significance in some instances is great, since they may produce permanent disability and even death Usually, the responsible factors are errors in selection of patients, choice and dose of contrast medium and technic of injection Since these are controllable variables, most complications should be preventable

In most aneurysms of the abdominal aorta, aortography is unnecessary It is primarily useful in incomplete aortic occlusion, and in the few patients in whom diagnosis remains doubtful If eliminated in patients with aneurysms and occlusive disease of the abdominal aorta, approximately two thirds of aortographies will not be done, and complications will be reduced to the same degree

Multiple aortic punctures and extravasation cause hemorrhage and pain Kidney damage is associated with injection directly into the renal artery, use of inorganic iodide compounds or injection of excessive contrast medium Therefore, certain principles in technic are suggested The aorta should be pierced only once, well above its major abdominal branches, and only 15-25 cc organic iodide should be manually injected A preliminary roentgenogram should be made after the first 5 cc has been injected to ascertain accurately the position of the needle

Dissection of Aorta as Complication of Translumbar Aortography Many complications of percutaneous lumbar aortography have been reported, including gangrene of gut from superior or inferior mesenteric arterial thrombosis, anuria and renal necrosis from injection into renal arteries, hypertension with retinopathy, acute pancreatitis from injection into the celiac axis, paraplegia, rupture of the aortic wall and chylothorax caused by damage to the thoracic duct On the

(6) Surg Gynec & Obst 104 129 141 February 1957

basis of 2 clinical observations and on experimental studies in which part or all of the contrast medium was injected into the media of the aorta, H Gaylis and J W Laws[7] (London) suggest that aortic dissection could account for a number of fatal complications The complication of aortic dissection is analogous to a spontaneous dissecting aortic aneurysm It may lead to misinterpretation in diagnosis if its true significance is not appreciated, may produce serious sequelae and may occur despite most scrupulous technic

Significance of Aortography in Diagnosis of Aneurysms of Abdominal Aorta is discussed by G Aurig and H Radke[8] (Berlin) Their observations are based on 6 patients, aged 53 74, who underwent aortography without complications None had a positive Wassermann reaction The contrast medium was injected into the aorta below the diaphragm at the level of the 12th thoracic vertebra

It is felt that aortography is superior to any other diagnostic procedure, as it provides exact information on localization, size, shape and function of the aneurysm Furthermore, serial films allow insight into the hemodynamics within the aneurysm, these always cause a prolonged passage of the contrast medium through the aneurysm which is estimated to be 4 or 5 times longer than the passage time through a normal aorta

► [illegible] aorta and with aor[illegible], expressed by these [illegible] necessary for diagnostic purposes For another, it does not always provide exact information on 'localization size and shape" of the aneurysm Since it is unnecessary in the preoperative evaluation of this lesion in most cases either for purposes of diagnosis or surgical approach and since it is sometimes associated with serious complications, such routine use of aortography is to be condemned —Ed]

Coarctation of Aorta was studied by W P Cleland, T B Counihan, J F Goodwin and R E Steiner[9] (Postgrad Med School, London) in 34 men and 18 women aged 1-55 Of the 40 who had resection, all were under 40, 25 were 15 or older The condition was discovered in 43 during medical examinations made for reasons unrelated to the coarctation The initial findings were heart murmurs in 26, hypertension in 12

(7) Brit M J 2 1141 1146 Nov 17 1956
(8) Fortschr Geb Rontgenstrahlen 84 661 670 June 1956
(9) Brit M J 2 379 390 Aug 18 1956

and pulsating neck swelling in 2, x-rays revealed the coarctation in 3 Manifest symptoms due to coarctation included dissecting aneurysm in 2 patients, subacute bacterial infection and cerebrovascular accidents in 3 each and congestive heart failure in 1 Silent complications occurred in others, which were unexpectedly found at operation

Intercurrent symptoms were headaches, dizziness, palpitations, dyspnea of effort, easy fatigability, faints, precordial or other chest pain and pains or heaviness in the legs

Saccular aortic aneurysms were recognized radiologically and found at thoracotomy, immediately beyond the coarctation in 2 patients Small saccular aneurysms occurred oftener on the intercostal arteries just below the coarctation, usually close to their origin from the aorta

In all patients the brachial blood pressure was elevated and affected both the systolic and diastolic pressure, except where the latter was lowered by aortic incompetence The hyper tension was well tolerated Uremia did not occur and heart failure was found only in association with valvular defects of the heart Stature development was retarded in many patients, the lower limbs being underdeveloped

Augmented carotid pulsation was characteristic A sus tained systolic arterial wave appears in the suprasternal fossa and travels outward along the subclavian arteries and up the carotids, where it is best observed Collateral arteries were often found around the scapulae In all patients, the femoral pulse wave was either of small amplitude with delayed peak or could not be felt In health the femoral pulse peak is reached before or synchronously with the radial, but coarctation delays the wave so the femoral peak is reached later than the radial

The precordial systolic murmur was often nondescript, but a characteristic murmur occurred in many patients, it was loudest at the sternal borders A mid diastolic murmur was heard preoperatively at the cardiac apex in 15 patients Electrocardiography showed left ventricular hypertrophy in 26 and suggested it in 6 others

X-ray films of 40 patients showed that the aortic arch was large or aneurysmal in 4, absent in 8, small in 5 and double in 10 Dilatation of the ascending aorta was shown in 15 The

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► [Our experience with aneurysms of the abdominal aorta and with aortography leads us to disagree completely with the views expressed by these authors For one thing aortography is only occasionally necessary for diagnostic purposes For another it does not always provide exact information on localization size and shape of the aneurysm Since it is unnecessary in the preoperative evaluation of this lesion in most cases either for purposes of diagnosis or surgical approach and since it is sometimes associated with serious complications such routine use of aortography is to be condemned —Ed]

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forward kink of the aorta at the point of coarctation and poststenotic dilatation caused a forward displacement of the barium-filled esophagus in 22 Notching of the lower rib margins from dilated tortuous intercostal arteries was found in 31 Left ventricular enlargement was seen in 30 Angiocardiograms were made through the venous route in 14 patients and the site of coarctation was outlined in all Surgery was aimed at an end-to end anastomosis that achieves a full aortic lumen at the site of the union It revealed in all instances an adult" type of coarctation

There were 3 postoperative deaths The other 37 patients have been followed from 3 months to 8 years, and all have remained in good health The arterial pulsation in the neck always diminished The femoral pulse increased in volume to within normal limits Collateral arteries were no longer palpable The murmurs were altered in all patients the precordial systolic murmurs became faint the early diastolic murmurs of aortic incompetence generally were unchanged and the mid-diastolic murmurs were less frequent The brachial blood pressure was reduced by the operation The size of the left ventricle, as seen by x rays, and left ventricular hypertrophy, as evidenced by ECG, usually remained unaltered after surgery Aortic dilatation and the posterior esophageal displacement generally disappeared

Closest approximation to normal pressures is probably obtained in patients in whom a uniform aortic lumen has been achieved, even though these pressures remain above normal levels Resection in all patients under age 40 is recommended unless contraindicated by severe associated cardiovascular anomalies unlikely to be affected by the resection The ideal time for operation is before adolescence

Surgical Treatment of Children with Coarctation of Aorta is discussed by A L d'Abreu and Clifford Parsons[1] (United Birmingham Hosp, England) Coarctation seems to be a potentially dangerous disease, and for any patient it is difficult to predict the future If a baby with coarctation has symptoms of heart failure, and if this failure shows no response to medical treatment, he is unlikely to survive more than a few months unless treated surgically During a 5 year

(1) Brit M J 2 390 393 Aug 18 1956

period at the Children's Hospital, Birmingham, 30 infants died from coarctation within 6 months of birth For the rest of the first decade a child with coarctation appears to be comparatively safe, but the hazard to life increases greatly after puberty and the chances of reaching the age of 40 are poor

Surgery was done on 11 patients, all under age 14, with coarctation of the aorta Although 8 benefited from operation 1 infant died, another improved temporarily and an older boy deteriorated after operation The postoperative death occurred in an infant with previous heart failure

The operation was easier and safer in children than in adults Surgery was followed by a progressive fall of blood pressure during several weeks Stricture formation may follow operative treatment, which is likely to have more serious consequences in infancy The best age for surgical repair of coarctation seems to be the second half of the first decade Earlier operation may be essential if symptoms of heart failure or subarachnoid hemorrhage develop

Hemodynamic and Clinical Appraisal of Coarctation Four to Seven Years after Resection and End-to-End Anastomosis of Aorta is reported by J Leo Wright, Howard B Burchell, Earl H Wood, Edgar A Hines, Jr, and O Theron Clagett[2] (Mayo Clinic and Found) The long term study included physical examination, determination of blood hemoglobin and leukocytes, urinalysis, electrocardiograms and teleroentgenograms of the thorax of 10 patients Catheterization of the right side of the heart was done along with puncture of the radial and femoral arteries

All patients were in good health at the time of study Murmurs did not change significantly in the patients as a group, although the systolic murmur diminished in 3 and became absent in 3 others In only 1 did the ECG show evidence of decreasing left ventricular hypertrophy Notching of the ribs, present in 9 patients before surgery, remained unchanged in 7, decreased in 1 and disappeared in 1 Cardiac size did not change appreciably except in 1 patient, who showed a decrease

Early after operation, the average radial systolic and di

(2) Circulation 14 806 814 November 1956

astolic pressure decreased 23 and 8 mm. Hg, respectively, whereas the average femoral systolic pressure increased 15 mm. Long-term observations indicated further decrease in the radial pressures and increase in the femoral pressure. Cardiac output was normal in all patients in whom it was measured, and calculated peripheral arterial resistance was slightly increased in 3.

The degree of coarctation improves dramatically in the immediate postoperative period and improvement continues, but to a lesser degree, in succeeding years. A slight to moderate measurable degree of residual coarctation persisted in 5 patients.

Necrotizing Panarteritis: Complication of Repair of Coarctation of Aorta is described by John B. Grow, Charles V. Demong and W. R. Rundles[3] (Denver). This condition is characterized by abdominal pain, distention, tenderness, fever, decreased peristaltic sounds and leukocytosis.

Autopsy usually reveals severe vascular changes only below the level of the coarcted segment of aorta. Muscular arteries of the mesentery show areas of acute necrosis and inflammation. The vessel lumens contain fresh and partly organized thrombus. The intima and internal elastic lamina are usually preserved, whereas the media shows severe destruction with fiber disintegration and mononuclear and leukocytic infiltration. Lober and Lillehei thought the vascular lesions closely resembled those in periarteritis nodosa.

At onset of abdominal pain following repair of a coarctation it seems advisable to stop all oral alimentation, maintain fluid and electrolyte balances intravenously, decompress the stomach and bowel by nasogastric tube and sterilize the intestinal contents with neomycin and Mycostatin® by mouth. Signs of intestinal perforation or hemorrhage from an involved artery should be watched for and laparotomy done if either occurs.

One Hundred Surgical Operations for Coarctation were evaluated by P. Santy.[4] All patients (68 males and 32 females were examined by the same cardiologist and operated on by the author and his assistants. Most had surgery sys-

(3) Am Surgeon 22 1168-1173, December, 1956
(4) Lyon chir 52-317-334, 1956.

tematically on the basis of diagnosis, but in 19 there were functional difficulties, such as headache, vertigo and epistaxis. Fifteen patients were aged 9 months to 8 years; 28, 8-15 years; 24, 16-21 years; 21, 21-27 years; and 12, 28-37 years. Four deaths occurred among the first 38 patients seen; the rest were operated on without fatality.

Four anatomic types of stenoses present different problems in the reconstruction of satisfactory continuity: (1) strangulation, the most favorable type (42 cases); (2) canalicular type (8); (3) short subjacent segment (34); (4) total absence of a substenotic segment (14); and (5) stenosis of the isthmus associated with a voluminous arterial canal (1). With 5 exceptions, Crafoord's technic was used. No grafts were used, and it is believed they are unnecessary. Experience has shown the importance of conservation of all collateral channels and of operating under controlled hypotension, produced by perfusion of Arfonad® (250 mg. in 500 Gm. physiologic solution).

The late results of Crafoord's operation have justified its early promise. In most patients, the equilibrium of pressure was achieved in all 4 extremities at a level below that seen preoperatively in the upper part of the body. In a previous report of the first 60 cases, objective evaluation showed 29 perfect results and 17 good results (arterial tension in lower extremities 1-2 cm. Hg lower than in upper extremities). In 4 patients, the results were fair, with relative hypertension (1-2 cm. Hg above normal for age) but definitely lower than before operation. In 4, the results were mediocre, with diminished femoral pulse and persistence of relative hypertension and some functional difficulties. Hence, good results were obtained in 78%. In the second half of the series, the results have improved definitely, because of the increased number of young patients, including very young children. Those operated on from age 10 months to 15 years showed the most perfect results; all were in the first 3 categories. Another cause of improved results has been constant care to preserve maximum collateral circulation.

Surgical treatment of coarctation is, at present, perfectly justified both by consistency and benignity of the postoperative course and by the quality of late results.

► [It would appear that a series as large as this, 100 cases, would be fairly representative, yet the author found it possible to restore aortic continuity by end to end anastomosis in all the cases Presumably, on this basis he believes that grafts are unnecessary This does not conform with other experience, including our own, in which it has been found that in approximately 20% of the cases the coarcted segment is of such length that excision requires the use of a graft to bridge the defect —Ed]

Resection of Aneurysms of Thoracic Aorta Michael E De Bakey, Denton A Cooley and Oscar Creech, Jr [5] (Baylor Univ) had a mortality rate of 29% for 86 lesions of the tho

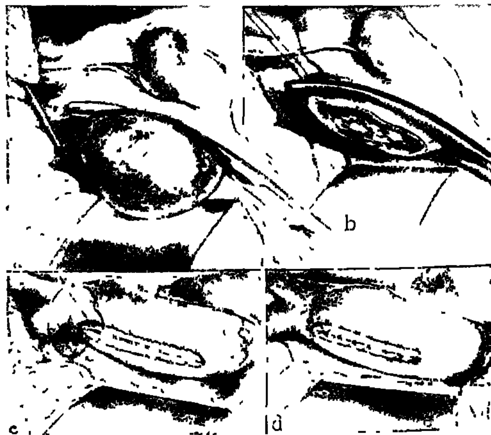


Fig 42 —Tangential exci ... form aortic aneurysm a occluding clamp is ... rysm b sac has been excised distal to clamp ... to repair defect using mattress sutures and ... and d (Courtesy of De Bakey M E et al ... ugust 1956)

racic aorta Aneurysms of the thoracic aorta may be sacciform, fusiform or dissecting

Sacciform aneurysms are usually of syphilitic origin and generally occur in the upper thoracic aorta The neck of the

(5) S Clin North America 36 969 98? August 1956

aneurysm is usually small. An anterior thoracotomy incision through the 3d or 4th intercostal space is used for lesions of the aortic arch For lesions involving the descending thoracic aorta, a left lateral thoracotomy with resection of an appropriate rib is used. The main surgical consideration is careful mobilization of the neck of the aneurysm. This is hazardous, since uncontrollable hemorrhage may occur. Once the neck is freed, lateral aortorrhapy is performed (Fig. 42). In

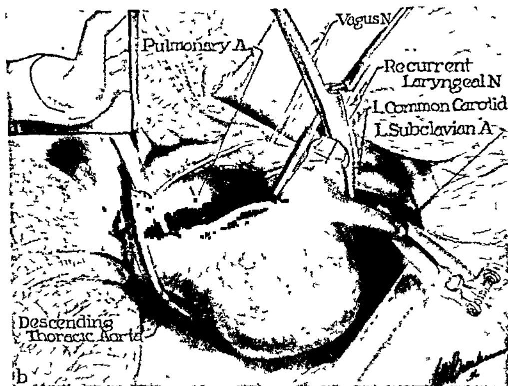


Fig 43 —Resection of fusiform aortic aneurysm *a*, left posterolateral thoracotomy incision with pleural cavity entered through bed of resected 5th rib *b* aorta proximal and distal to aneurysm has been freed from surrounding structures permitting application of occluding clamps to transverse arch just distal to left common carotid artery, to subclavian artery and to descending thoracic aorta below aneurysm. Circulation will then be completely arrested through aneurysm, permitting resection of this aortic segment (Courtesy of De Bakey, M E, *et al* S Clin North America 36 969 982, August, 1956)

some cases, the carotid artery may be sacrificed if its collateral circulation is adequate.

Because fusiform aneurysms tend to involve the entire circumference of the aorta, their extirpation usually necessitates resection of varying segments of the aorta itself. Aortic continuity is restored with aortic homografts which have

been prepared by freeze-drying Aortic circulation must be temporarily arrested The higher the level of occlusion and the longer the interruption of aortic circulation, the greater

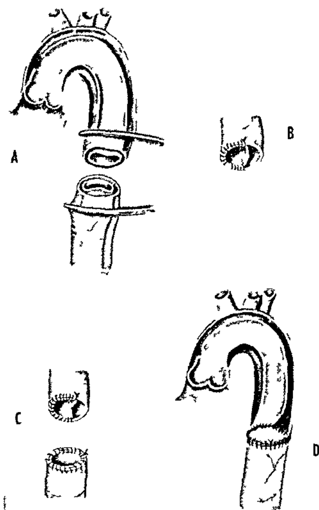


Fig 44—Operative method for dissecting aneurysm in ascending *aorta* *A* descending thoracic aorta is divided between occluding clamps revealing double barreled openings representing inner true and outer false lumens *B* wedge shaped segment of inner wall (dotted line) is excised to create re entry passage from false to true lumen *C* inner and outer walls in lower opening of aorta are approximated by continuous suture of 000 silk to obliterate false passage *D* two ends of *aorta* approximated by end to end anastomosis restoring blood flow from double aortic lumen above to single normal lumen below (Courtesy of De Bakey M E, *et al* S Cl n North America 36 969 982 August 1956)

the risk of ischemic damage to the tissues distally The organ most vulnerable to ischemic changes is the spinal cord Hypothermia is used for aneurysms arising in the descending thoracic aorta between the levels of the left subclavian artery

and the 8th dorsal vertebra. Fusiform aneurysms involving the aortic arch require a temporary shunt to bypass the arch. This can be done with specially molded shunts of compressed polyvinyl sponge which are attached as end-to-side anastomoses to the ascending aorta above and descending aorta below with 2 limbs of the shunt similarly attached to the carotid arteries.

For fusiform lesions involving the aortic arch proximal to the left subclavian artery, adequate exposure may be obtained by a bilateral transsternal thoracotomy through the 3rd interspace and a vertical median sternotomy incision ex-

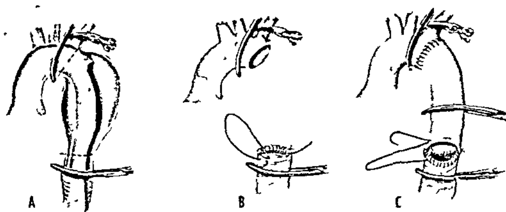


Fig 45.—Operative method for dissecting aneurysm arising at level of left subclavian artery *A*, occluding clamps are applied to aorta proximal to origin of aneurysm, to left subclavian artery and to descending thoracic aorta well below fusiform dilatation of dissecting process. *B*, intervening segment of aorta between clamps has been excised Inner and outer walls in lower opening of aorta are approximated by continuous suture of 000 silk to obliterate false passage. Since aneurysm has been excised proximal to origin of dissecting process, only true lumen remains in proximal opening of aorta *C*, aortic homograft used to restore continuity between two ends of aorta (Courtesy of De Bakey, M. E, *et al* S Clin North America 36 969 982, August, 1956)

tending into the suprasternal notch at the base of the neck. For aneurysms arising between the level of the left subclavian artery and the 8th dorsal vertebra, a posterolateral incision is used For those below this level, a left thoracoabdominal approach is used. Once adequate exposure is obtained, the aorta proximal and distal to the aneurysm is mobilized The aneurysm should not be freed completely until the aorta is mobilized The aorta is then occluded (Fig. 43), the aneurysmal segment removed and an aortic homograft inserted with use of a simple continuous through-and-through suture of 000 or 4-0 arterial silk.

Dissecting aneurysms of the aorta are usually due to degeneration of the elements of the media The aorta may become perforated and the patient die of hemorrhage Hemorrhage may be delayed a few days or weeks before death occurs, or the dissected passage in the aorta may re enter the aorta at a lower level and form a "double barreled" aorta The object of surgery, if the dissection originates in the ascending aorta, is creation of a re entry passage into the true aortic lumen above with obliteration of the false passage below (Fig 44) If the dissection arises at or below the level of the left subclavian artery, surgery consists of removal of the involved segment of aorta under hypothermia and substitution of an aortic homograft (Fig 45)

Cure of Dissecting Aneurysm of Thoracic Aorta by Total Excision Thus far, the only reported successful surgical efforts in dissecting aneurysm of the thoracic aorta have been procedures that mimic nature's occasional cure and divert the false channel back into the aortic lumen De Bakey, Cooley and Creech have demonstrated that good results can be obtained by dividing the thoracic aorta in the area of dissection and repairing it in such a way as to close the inner and outer coats of the distal segment, leaving a window between the two proximally Occasionally, a patient survives a limited dissection with a persistent aneurysm *Harris B* Shumacker Jr and Jackson Harris[6] (Indiana Univ) describe such a patient treated by total excision and grafting

Woman 34, had a large thoracic aneurysm originating immediately distal to the origin of the subclavian artery and extending to within 2 3 in of the diaphragm The aneurysm arose so close to the subclavian that it was necessary to clamp tangentially across the lateral portion of the artery to leave a small aortic cuff for anastomosis The aneurysm was removed and a curved Nylon filter fabric graft 6 4 cm in circumference was sutured to the aortic arch above and distal to the thoracic aorta below The aorta was cross clamped 50 minutes Postoperative recovery was relatively uneventful Examination of the excised specimen disclosed a dissecting aneurysm due to cystic medial necrosis Dissection had taken place through a small opening, 3 mm in diameter through the intima and into the medial layer in the proximal portion of the descending aorta

Problems in Surgical Management of Acute Dissecting Aneurysm of Aorta were studied by W Dean Warren, Julian Beckwith and William H Muller, Jr[7] (Univ of Virginia)

(6) A M A Arch Surg 73 991 994 December 1956
(7) Ann Surg 144 530 548 October 1956

The principal reasons for operation are high mortality (75-90%) in nonsurgical management and the nature of the so-called healed dissection, with most cases rupturing back into the true lumen of the aorta distally, forming a re-entry site for the aneurysmal channel Conversely, the usual cause of death in rapidly fatal cases is hemorrhage from external rupture

The first problem in management is establishing diagnosis Differential diagnosis most commonly includes either myocardial infarction or an intra-abdominal emergency A high index of suspicion, severity and localization of pain, history of hypertension, difference in peripheral pulses and bloody pericardial or pleural effusion are salient factors in differentiation In the authors' series, diagnosis was correct in 5 of 6 patients, the other proved to have a myocardial infarction with bleeding into the pericardial cavity and cardiac tamponade Intrapericardial rupture of an acute dissecting aneurysm was also discovered at autopsy in a patient who died 12 hours after hospitalization for supposed myocardial infarction

The most critical period is the first 48 hours Operative risk in very early cases is outweighed by extreme gravity of prognosis, and emergency surgery should usually be done In cases of longer standing, additional time may be taken for diagnostic studies and to improve the general condition, as in the following case

Woman, 56 was hospitalized Consistently low blood pressure in the right leg focused attention on the aorta, but diagnosis was not established until an aortogram was done on the 8th day After this, blood urea rose markedly, and surgery was delayed for 2 weeks until renal function approached normal Operation disclosed a well formed aneurysmal channel involving two thirds of the circumference of the descending aorta The opening into the distal dissection was closed with a continuous silk suture a crescent of proximal intima was excised as a re entry site and the ends of the aorta were anastomosed (Fig 46) Postoperative recovery was uneventful and she was doing well except for gradual return of blood pressure toward preoperative level

For finding the aneurysm and controlling an external perforation, a transthoracic exploration should be used, except in patients with complete obstruction to the distal aorta or iliac arteries or in the occasional patient with intra abdomi-

nal hemorrhage. Aims of operation are (1) prevention of distal extension of the aneurysm, (2) creation of a distal reentry site for the aneurysmal sac, (3) prevention and/or relief of arterial obstruction and (4) control of hemorrhage from the aneurysm (including relief from cardiac tamponade). Unfortunately, these cannot be realized in all patients

Frequent localization of lesions to the ascending aorta or arch imposes technical limitations, preventing complete di-

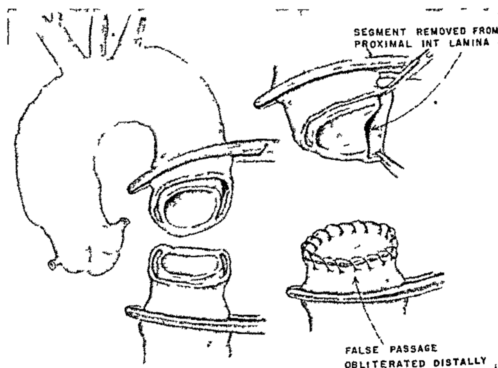


Fig 46—Basic steps in operation (Courtesy of Warren W D *et al* Ann Surg 144 530 548 October 1956)

vision of the aorta with repair as used *in the distal portion* A somewhat similar problem is related to blood pressure changes coincident to cross clamping the descending aorta, which may lead to perforation of the proximal aorta with external hemorrhage or extension of the dissecting process in proximal vessels Hypertension should be controlled by beginning Arfonad® before application of the occluding clamps and maintaining the pressure at desired level by altering rate of flow during aortic occlusion Before removal of the aortic clamps a vasopressor agent should be prepared for intrave-

nous use in case it is needed The distal clamp may be removed to test effectiveness of the anastomosis, but the proximal clamp should be slowly released over several minutes and reapplied if a sudden drop in pressure occurs In postoperative management, weight reduction, restriction of activity, sedation and antihypertensive medication should be used when indicated

Only 1 of the authors' 6 patients survived, but with increasing experience in surgical management of these acute cases, the extremely poor prognosis should improve

► [These two reports by Shumacker and Harris and by Warren, Beckwith and Muller provide encouraging support of the value of surgical attack on dissecting aneurysms of the aorta The problem is indeed a challenging one particularly during the acute stage of the disease This, of course, accounts for the high mortality reported by the latter authors Their efforts, however, seem justifiable in light of the even higher mortality following nonoperative therapy Our own experience now includes 27 cases with an over all mortali [illegible] ost of these cases it was possib [illegible] graft replacement of the segm [illegible] with suture closure of the fal [illegible] re of choice and is readily applicable in cases in which the dissection begins at or just below the level of the left subclavian artery The problem is far more difficult in the group in which the dissecting process originates in the ascending aorta Since in most of these cases death takes place fairly rapidly, the opportunity to attack this problem surgically occurs less commonly Follow up observations up to 3 years in our cases reveal maintenance of the early good results —Ed]

Symposium on Abdominal Aortic Aneurysm. Nigel Kinnear[8] (Adelaide Hosp , Dublin) states that most of the aortic arch and descending aortic aneurysms are syphilitic whereas nearly all abdominal aneurysms are arteriosclerotic According to a recent survey in the literature, rupture of the aneurysm caused death in only 30% of cases , associated myocardial, coronary or renal disease accounted for the other deaths Rupture is more commonly associated with saccular aneurysms than with fusiform Patients with abdominal aortic aneurysms may have left ventricular hypertrophy, and the pulse and pulse pressure are smaller in vessels distal to the aneurysm A pulsating, perhaps tender, tumor often can be felt X-ray study frequently shows calcification of the aorta and delineation of the sac Indirect evidence, in the form of bone erosion and displacement, often is seen Aortography is helpful in outlining the sac

(8) Irish J M Sc pp 158 163 April 1957

The commonest form of abdominal arteriosclerotic aneurysm begins an inch or more below the renal vessels and involves one or both common iliac arteries This type is best treated by excision and replacement by a homograft or polyvinyl prosthesis Considerable symptomatic relief may be obtained from palliative treatment, such as insertion of Colt's umbrella, insertion of lengths of wire, electrocoagulation after insertion of silver wire into the aneurysm and wrapping the aneurysm with cellophane tape Wiring is particularly applicable to saccular aneurysms of the thoracic and lower abdominal aorta, but must be used with caution in the vicinity of the superior mesenteric and renal vessels Wiring should be done under radiologic control

► [It is difficult to believe that a paper published as late as April 1957 would advocate the use of such ineffective and now obsolete methods as insertion of wire and cellophane wrapping for the treatment of aneurysms of the aorta —Ed]

Aortic Aneurysm· Report of 101 Cases is presented by Brooke Roberts, Gordon Danielson and William S Blakemore[9] (Univ of Pennsylvania) Of 65 patients with abdominal aortic aneurysms, 30 were operated on Exploration without execution of any definitive procedure was done in 2, the aneurysm was wrapped with cellophane in 2 and excised in 26 There were 8 (31%) operative deaths among those in whom the lesion was excised, 4 occurring in patients with ruptured aneurysms and the others resulting from rupture of the graft at 28 days, pulmonary embolus, thrombosis of the graft and cerebral hemorrhage 4 weeks postoperatively Of 35 patients not operated on, 16 died as a direct result of the aneurysm and 8 of other causes

Of 36 patients with aneurysms of the thoracic aorta, 10 had surgery There were 5 operative deaths and 1 patient died within a year after surgery With the recent development of hypothermia and vascular shunts however, more favorable results should be obtained Of the 26 patients not operated on, 14 died within a year

Pain when present with abdominal aneurysms was the dominant symptom It usually was felt in the back or epigastric area but occasionally was experienced in the region of the hip or even the leg Among the patients with thoracic aneurysm, pain was again the dominant symptom Here,

(9) Circulation 15 483 491 April 1957

however, additional symptoms were noted, arising from compression of structures lying within the thorax

► [The operative mortality of 50% for thoracic and 33% for abdominal aneurysms of the aorta obtained by these authors is relatively high as compared with those reported by others (see following report) As indicated by these observers, however, the operation "will become less hazardous as more experience is gained in the procedure"—Ed]

Aneurysm of Aorta Treated by Resection: Analysis of 313 Cases Aortic aneurysm, when untreated, is a progressively disabling, ultimately fatal disease with an average survival of 1 or 2 years after diagnosis There was no satisfactory treatment until a few years ago, when a method of surgical correction was developed in which the diseased portion is

ANEURYSMS OF AORTA TREATED BY RESECTION

TYPE	CASES		DEATHS			
			NO		%	
Thoracic						
Sacciform	24		9		37	
Fusiform	43		14		33	
Dissecting	16		3		19	
Subtotal		83		26		31
Abdominal						
Ruptured	27		9		33	
Nonruptured	203		17		8	
Subtotal		230		26		11
Total		313		52		17

excised and normal function restored by repair or by replacement with a homograft During the 5 years since their first successful resection of an aortic aneurysm, Michael E De Bakey Denton A Cooley and Oscar Creech, Jr [1] (Houston) used this method in 313 cases, as shown in the table

Application and results of treatment depend on the nature and location of the aneurysm Three types are encountered in the thoracic aorta sacciform, fusiform and dissecting Sacciform aneurysms are readily extirpated by applying an occluding clamp tangentially across the neck of the aneurysm without encroachment on the aortic lumen The more proximal the aneurysm arises the higher is the risk of operation, as evidenced by the fact that 7 of the 9 deaths occurred among the 15 patients with aneurysms arising in the ascending aorta Fusiform aneurysms of the thoracic aorta require resec-

(1) J A M A 163 1439 1443 Apr 20 1957

tion of the diseased segment, with restoration of continuity by an aortic homograft or suitable plastic substitute. This requires temporary arrest of aortic circulation, and to overcome its consequent ischemic effects, especially on the central nervous system, hypothermia or temporary shunts around the occluded segment may be effectively employed for this purpose for lesions located above the level of the 7th thoracic vertebra. For lesions lying below this level neither of these measures appears to be necessary, providing the procedure is performed expeditiously. The surgical approach to dissecting aneurysms of the aorta is concerned with prevention of further intramural dissection and terminal rupture by creating conditions compatible with function and eventual repair. For aneurysms arising in the ascending aorta, the procedure consists in making a re-entry channel from the dissecting passage to the true lumen high in the descending thoracic aorta, with obliteration of the false passage below. The second method consists in excision of the segment of aorta in which dissection begins, with obliteration of the false passage below and replacement of the excised segment with an aortic homograft. The latter procedure, considered to be a more curative type of operation, was performed in 12 of 16 cases. Postoperative control of hypertension is considered important since 2 of the 3 deaths in this series resulted from rupture believed to be due to inability to control this factor.

Aneurysms of the abdominal aorta, except in presence of rupture, present a much simpler surgical problem with less risk than those located elsewhere. In most cases the lesion arises below the origin of the renal arteries, but involvement of these vessels no longer constitutes contraindication to operation, and experience has demonstrated that it is possible to excise such aneurysms successfully with restoration of continuity to the renal arteries. Diagnostic lumbar aortography for these lesions is considered unnecessary.

With increasing experience in management, operative mortality has decreased from 25% in the first year to less than 2% in the last year. The most important factors contributing to risk of operation are advancing age, hypertension, pre-existing heart disease and acute rupture of the aneurysm. The fatality rate in patients in the 8th decade was twice that of patients in the 4th and 5th decades, the respective figures

being 14 and 7%. Similarly, among hypertensive patients it was almost 4 times greater than in normotensive patients Mortality in patients with pre-existing heart disease was more than 3 times that in patients without heart disease, the

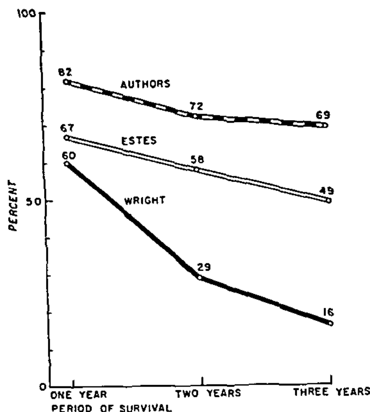


Fig 47 —Life expectancy of patients with aneurysm of abdominal aorta as found in this study and by others (Courtesy of De Bakey, M E, *et al* J A M A 163 1439 1443, Apr 20, 1957)

mortality in those of the latter group under 65 being only 2% More than one third of all deaths occurred among patients with acute rupture, but of significance is the fact that 67% of the 27 patients with acute rupture survived

Results of follow-up studies after 3½ years have been most gratifying and reveal a significant increase in life expectancy (Fig 47)

Ligation of Both Celiac Axis and Superior Mesenteric Artery with Survival of Patient is reported by C G Rob and Kenneth Owen [2]

Man, 35, had a syphilitic aneurysm of the upper abdominal aorta

(2) Brit J Surg 44 247 249, November, 1956

At a previous operation, the splenic artery had been opened and a cannula inserted through this opening into the aneurysm, which was wired Despite this, the aneurysm appeared to be enlarging and a 2d operation was performed under hypothermic anesthesia The aneurysm was approached through a left thoracoabdominal incision by reflecting forward the spleen, stomach and pancreas, and was found to extend from just below the diaphragm to the renal arteries The 3 branches of the celiac axis arose from the front while the superior mesenteric artery arose from its lower part Incision of these arteries



Fig 48—Postoperative aortogram after resection of aneurysm and replacement with polyvinyl alcohol implant showing hypertrophic inferior mesenteric artery and enlarged lower intercostal arteries Note absence of both celiac axis and superior mesenteric arteries (Courtesy of Rob C G and Owen K Brit J Surg 44 247 249 November 1956)

showed no flow from the proximal end so all 4 were ligated The aneurysm was removed after clamps had been applied to the aorta above and below and to both renal arteries A tubular prosthesis of polyvinyl alcohol sponge (Prosthex) was sutured into position The clamps were in position for 96 minutes The patient's recovery was uneventful and there was no clinical evidence of disability from loss of upper abdominal blood supply Postoperative liver function tests were normal Aortogram 2 weeks after operation showed no branches of the aorta between the 11th intercostal artery and the renal arteries (Fig 48 *left*) The inferior mesenteric artery was hypertrophied with a large ascending left colic branch and appeared to be the sole abdominal visceral supply (Fig 48 *right*)

Maintenance of good collateral arterial supply to the upper abdominal organs without hepatic insufficiency may have been aided by occlusion of the celiac axis branches and superior mesenteric occurring slowly and in stages. Several similar cases were reported previously.

Aneurysm of Thoracoabdominal Aorta Involving Celiac, Superior Mesenteric and Renal Arteries: Report of Four Cases Treated by Resection and Homograft Replacement is presented by Michael E. De Bakey, Oscar Creech, Jr., and

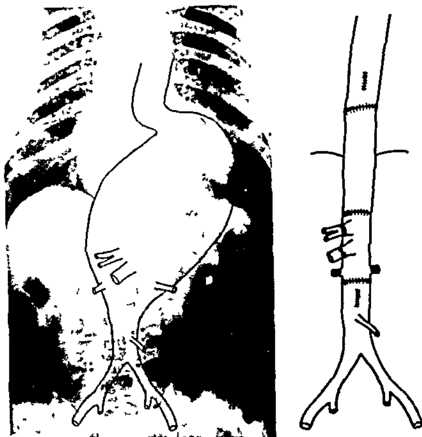


Fig 49.—Composite x ray of chest and abdomen with diagram superimposed to show location and extent of thoracoabdominal aneurysm Replacement of excised segment of aorta and aneurysm by homograft with restoration of continuity of aorta, celiac, superior mesenteric and renal arteries is shown in diagram on right (Courtesy of De Bakey, M E, *et al* Ann Surg 144 549 572, October, 1956)

George C. Morris, Jr.[3] (Baylor Univ.). Fortunately most aneurysms arise below the origin of the renal arteries. In the few which involve major branches of the abdominal aorta, the problem is grave In the present cases, surgery consisted

(3) Ann Surg 144 549 572, October, 1956



Fig 50—*Drawings made at operation. a*, patient placed supine with left shoulder slightly raised and left arm [illegible] used *b*, aorta above and below [illegible] teric and left renal arteries ar[illegible] about them. Right renal artery [illegible] *c*, shunt made of compressed [illegible] astomosis to descending thoracic aorta above aneurysm and to abdominal aorta below. (Courtesy of *De Bakey*, M E, *et al* Ann Surg 144 549 572, October, 1956)



Fig 51 —*a* anastomosis of left renal artery to its comparable segment on aortic homograft *b* anastomosis of distal end of aortic homograft to abdominal aorta *c* occluding clamp is applied to graft after clamp on abdominal aorta has been released *d*, anastomosis of graft to superior mesenteric artery *e* anastomosis of celiac artery *f*, with occluding clamp reapplied above the celiac artery anastomosis, final anastomosis to descending thoracic aorta above is completed (Courtesy of De Bakey, M E, *et al* Ann Surg 144 549 572, October, 1956)

of excision of the aneurysm and replacement with a homograft, restoring continuity to the celiac axis and superior mesenteric arteries in all 4, as well as to both renal arteries in 2 and to one renal artery in the other 2 (Figs 49 51)

TECHNIC —Adequate exposure is obtained with a left thoracoabdominal approach (Fig 50, *a*) Left pleural and peritoneal cavities are entered, costal cartilages divided and diaphragm incised radially, the aneurysm can then be visualized in its entire extent Umbilical tape is placed around the aorta above and below the aneurysm and around the major visceral branches (*b*) The shunt, previously prepared, is sutured into place by end to side anastomosis with the use of partial tangential occlusion clamps, to the descending thoracic

aorta above the aneurysm and the abdominal aorta above the bifi cation (*c*). Polyvinyl sponge, lumen 14 mm diameter, has b found satisfactory The *aneurysm is then* freed by sharp and bl dissection and special noncrushing arterial occlusion clamps are a plied to the aorta and major branches, arresting circulation throu the aneurysm Aortic continuity is restored by a properly fitted a dominal aortic homograft, including the branches of the celiac, su rior mesenteric and renal arteries

To minimize circulatory arrest to vital organs, the left renal arte is attached first to the graft, end-to-end, using continuous throug and-through sutures of 5-0 arterial silk (Fig 51, *a*) and the gr united similarly to the abdominal aorta (*b*) An occlusion clamp applied obliquely above the left renal artery but below the origin of t right artery and the occluding clamp on the abdominal aorta imm diately above the lower attachment of the shunt is released (*c*), w restoration of circulation to the left renal artery through the shu The same procedure is used for the right renal artery An occludi clamp is then applied above the origin of both renal arteries, l below the superior mesenteric artery and the previously applied cla is released, permitting blood flow into both renal arteries duri anastomosis of the superior mesenteric artery (*d*) The clamp then moved above the superior mesenteric artery while the celiac a is anastomosed (*e*) The maneuver is again repeated and the fi anastomosis made between the graft and the opening in the low thoracic aorta (*f*) In this manner, circulation via the shunt is stored successively into each major visceral artery as rapidly as anastomosis is performed

With the final anastomosis to the thoracic aorta occludi clamps are removed and blood flows normally through the graft T shunt is then removed and openings in the aorta closed with a co tinuous suture of arterial silk

The most important consideration in removal of ane rysms of this type is the potential ischemic damage to su vital organs as the kidneys, liver and gastrointestinal tra because of temporary arrest of circulation to them durin the procedure Two methods are available to overcome th problem hypothermia and temporary shunts around the o cluded segment as indicated above Hypothermia was used 1 patient, but he died of renal failure a week after surger The other 3 had temporary shunts and all were successfu The period of occlusion of the celiac artery ranged from to 116 minutes, with no detectable hepatic dysfunction Ci culation to the superior mesenteric artery was arrested f 36-102 minutes without significant disturbances in gastr intestinal function

Major Arterial Grafting in 169 Consecutive Cases: Preliminary Report on Incidence of Success and Failure is presented by A W. Humphries, V. G deWolfe and F. A. LeFevre[4] (Cleveland Clinic). Of 169 grafts, followed as long as 27 months, 102 were in the aortoiliac region, 63 were femoropopliteal, 3 were in the renal arteries and 1 was a carotid artery All but 1 patient received freeze-dried homografts sterilized in ethylene oxide The initial failure rate was 14%, the late failure rate 3% and the mortality rate 11% The continued success rate was 72% The initial success rate for aorto-iliac grafts ranged from 89 to 100%, for aortic aneurysms it was 100%, for femoropopliteal grafts, 62-82%, and for carotid and renal grafts, 100% each The elective grafts were 81% successful, whereas the nonelective were only 44% successful in the long follow-up

No amputations were necessary because of failure of a graft in a patient who was not admitted with amputation in mind All patients with failures, excepting those who died, had no pulses distal to the graft, although many improved clinically The initial failures in 4 aortoiliac grafts were due to inadequate exit flow in 3, and the reason was unknown in 1 Of 20 initial femoropopliteal failures, 16 were due to inadequate exist flow, in 3 the reason was unknown, 1 had polycythemia and 8 were due to bypass with cut-down thoracic grafts

All of the 5 late failures, exclusive of death, were due to advanced disease in the patient's own arteries and in the graft itself or the result of trauma to the graft Of the 18 deaths, 10 were due to failure of the graft and include 3 infections and 7 postoperative leaks Other causes were 3 transfusion reactions, 1 pulmonary edema, 1 coronary occlusion, 2 ventricular fibrillation and 1 myohemoglobinuria

The best method of studying the patient preoperatively is by angiography An angiogram should be made of all gangrenous and pregangrenous limbs, since about 50% of apparently irretrievable limbs can be saved by arterial grafting. The 81% continued success rate in elective cases encourages the belief that arterial grafting will continue to be useful in the treatment of arteriosclerotic aneurysms and arterio-

(4) A M A Arch Surg 74 65 70, January 1957

sclerosis obliterans involving the large peripheral vessels

► [The 6% incidence of fatal homograft complications seems somewhat high Since most of these complications were in patients who "developed a postoperative leak and died because of hemorrhage," they may be considered technical failures rather than failures attributed to the use of homografts With increasing experience and improvements in technic, these complications should be reduced to a minimum —Ed]

Arteriosclerotic Occlusion of Aorta. Case Presenting Unusual Location is reported by Samuel P Harbison[5] (Univ

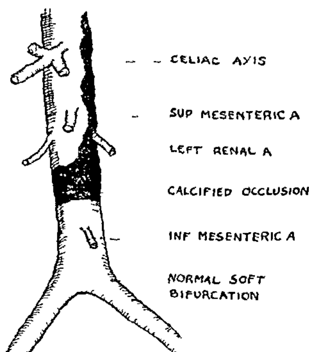


Fig 52 —Occlusive lesion found at operation (Courtesy of Harbison S 1 Surgery 41 488 490 March 1957)

of Pittsburgh) Two somewhat similar cases were previously reported by Cooley and De Bakey

Man, 38 had numbness and pain on exertion in the feet, calves and thighs and displayed no pulsations in the abdomen below the umbilicus and in the lower extremities Oscillometric readings in the lower extremities were exceedingly low in all positions, and blood pressure in the legs could not be obtained At exposure of the aorta at operation, the common iliac vessels the bifurcation and 3 in of the lower aorta were soft compressible and felt normal except for absent pulsations Beginning less than ½ in above the inferior mesenteric artery, there was an exceedingly hard plug about 2 in long which totally occluded the aorta (Fig 52) Above this, the aorta was irregularly in

(5) Surgery 41 488 490 March 1957

durated, representing calcification up to the celiac axis The aorta was compressible at the level of the renals The aorta was freed from just above the bifurcation to the renals, the inferior mesenteric artery was then divided and revealed a normal lumen and no evidence of thrombosis or disease Endarterectomy resulted in good pulsatile flow from above, and release of the aortic clamp restored all pulses down both legs Bilateral lumbar sympathectomy was also performed. The patient recovered promptly, and 10 days after operation, oscillometric readings in both calves were 8 Dorsalis pedis and posterior tibial vessels pulsated well Blood pressure in right arm was 125/70 and in right leg 150/95

► [This is an interesting type of occlusive lesion of the aorta Our experience now includes 6 cases, all of which were successfully treated mostly by endarterectomy Pathologic studies of the obstructive lesion reveal changes typical of atherosclerosis and organized thrombus not much different from the more common form of the disease occurring at the bifurcation of the aorta In some instances, however, the aortic wall and periaortic tissues

is observed at operation, suggesting

f Branches of Aortic Arch.

Pulseless, or Takayashu's, disease is an unusual syndrome characterized by obliteration of major branches of the aortic arch Consistently, intravascular clots have been demonstrated, associated with inflammation of the vessel wall restricted to this area Although 90 cases have been reported thus far, only 5 originated in this country Robert B Kalmansohn and Richard W Kalmansohn[6] (Univ of California, Los Angeles,) now report a 6th

Age at onset was 11-64, and the condition occurred chiefly in young women Symptoms and signs are due to inadequate circulation, collateral circulation and associated difficulties Most patients complained of dizziness or vertigo, often precipitated by physical exertion Some had aphasia, syncope, headache, transitory hemipareses or hemiplegia, convulsions or mental impairment Eye symptoms included amaurosis fugax, black spots, amblyopia, decreased visual acuity, glaucoma and retinal and optic atrophy Inadequate circulation to the face may result in muscular atrophy, ulcerated palate, perforated nasal septum, claudication of mastication muscles and saddle nose deformity Inadequate circulation to the upper extremities may result in rapid exhaustion, claudication, absent pulsations, trophic nail changes or ischemic color changes

(6) Circulation 15 237 244 February 1957

The involved vessels show a panarteritis involving all layers of the wall, without fibrinoid necrosis The inflammatory infiltrate consists chiefly of lymphocytes and plasma cells predominantly involving the media and vasa vasorum The intima usually proliferates along with fibroblastic proliferation of the media

The etiology is unknown, hence there is no specific treatment Certain general therapeutic measures are indicated smoking should be eliminated, digitalis should be used cautiously because it increases sensitivity of the carotid sinus and long term anticoagulant therapy appears rational because of the arterial occlusions More definitive therapy may be available in the future with the advance in technics of *endarterectomy, local resection and homotransplantation*

Relief of Neurologic Symptoms and Signs by Reconstruction of Stenosed Internal Carotid Artery is reported by Colin Edwards and Charles Rob[7] (London) in a man, 56, who was unable to sign his name had difficulty speaking and had abnormal *pyramidal signs and symptoms in his right* upper and lower limbs These neurologic abnormalities had been present for eight weeks Reconstruction of the internal carotid artery was followed by immediate and complete relief of these abnormalities

The authors believe that correct treatment of partial occlusion of the internal carotid artery is surgical because of the disability it causes and because of the great risk of complete carotid occlusion By this means, 3 patients were *completely* relieved, 2 greatly improved and 6 with complete occlusions had been made no worse by exploration of this vessel, there were no deaths The alternative is long term anticoagulant therapy It is felt this should be used after operation to reduce, *if possible, occurrence of further* thrombosis in this vessel or elsewhere

The operation is aimed at restoring the flow through the internal carotid artery This may be achieved by direct anastomosis thromboendarterectomy or arterial graft or transplant, depending on the type of abnormality The authors used each of these procedures with success in patients requiring reconstruction of the carotid arteries Hypothermia is valuable in this type of surgery

(7) Brit M J 2 1265 1267 Dec 1 1956

Thrombic Occlusion of Branches of Aortic Arch, Martorell's Syndrome: Report of Case Treated Surgically The "Martorell syndrome" is due to occlusion of branches of the aortic arch It may develop in young people and remain unnoticed for some time because of its slow development which permits good collateral circulation to form The slow course with development of collateral circulation is analogous to that of the Leriche syndrome (chronic aortic bifurcation occlusion) The syndrome has also been called "pulseless disease" It is characterized by atrophy of the face, epileptic-like attacks due to compression of the carotid bifurcation, headaches, ocular nerve atrophy without papilledema, absence of carotid, subclavian, brachial, cubital and radial pulses bilaterally, weakness and paresthesias of the upper extremities, slight hypertension of the lower extremities and progressive weight loss No definite cause has been ascribed to this vascular lesion John B Davis, William J Grove and Ormand C Julian[8] (Univ of Illinois) present a case

Man 51, with Martorell s syndrome, had obstruction of the right innominate artery and partial obstruction of the left subclavian artery At surgery, a considerable amount of thrombotic and sclerotic debris was removed from the innominate artery Eventually, a fairly good pulsation was palpable in the innominate artery and a weak one in the carotid However, there was no palpable pulsation in the subclavian artery Follow up after about 16 months revealed that he no longer had attacks of syncope numbness or weakness in the right arm and no long[illegible]

► [The 3 [illegible] ies of the aortic arch [illegible] emphasis Although t [illegible] ibent, except for the [illegible] Japanese ophthalmologists little interest in the disease was aroused until recently following particularly the report of Shimizu and Sano in 1951 who used the eye catching title pulseless disease An increasing number of reports have since appeared in both the American and European literature suggesting that it has widespread geographic distribution and probably occurs more frequently than previously realized

Althe [illegible] believe [illegible] terns a [illegible] the dista[illegible] of the aorta Thus in the latter form two broad groups may be recognized namely the proximal aortoiliac and the more peripheral femoral type A similar pattern of a proximal and distal form of occlusive disease may occur in the upper branches of the aorta In the proximal form the obliterative process tends to arise in the origin of the innominate, left

(8) Ann. Surg 144 124 126 July 1956

common carotid and left subclavian arteries, whereas in the distal form it tends to involve the bifurcation of the common carotid arteries A particularly significant pathologic feature of all of them is the tendency for the occlusive process to be well localized and segmental in character, with a patent lumen both proximal and distal to the occlusion The significance of this fortunate pathologic feature of the disease lies in the fact that it permits direct surgical attack on the occlusive process in re establishing arterial continuity and normal circulation One of three methods may be employed for this purpose, namely thromboendarterectomy, the use of a bypass graft, and excision with graft replacement The first two of these methods have proved the most satisfactory in our experience, and the results have been most gratifying —Ed]

Aneurysm of Common Carotid Artery Treated by Excision and Primary Anastomosis Treatment of an aneurysm of the common carotid artery is hazardous because ligation results in hemiplegia in 15 25% of patients A number of tests have been used to evaluate the safety of carotid ligation, but none is completely reliable, probably because hemiplegia may not develop for several hours after ligation Frank C Spencer[9] (Johns Hopkins Univ) reports a case in which treatment was successful

Man, 42, had an aneurysm of the common carotid artery for 8 years A cerebral embolus from the blood clot in the aneurysm caused transient hemiplegia The diagnosis was missed because pulsations usually seen in an aneurysm had been obliterated by extensive clot formation within the lumen, the mass then had the physical characteristics of a solid tumor The patient was successfully treated by excision of the aneurysm and anastomosis of the common and internal carotid arteries

Preservation of the carotid artery in this patient minimized the danger of hemiplegia Many peripheral aneurysms and especially those due to syphilis, result from localized rupture in the arterial wall therefore, only a short segment of artery need be removed This possibility can be evaluated by opening the aneurysm, as in the case described, before a large segment of vessel is needlessly sacrificed As an arterial homograft can be used when a direct anastomosis cannot be done, it should be possible to preserve the carotid artery in most instances

Aortic Homograft Substitution and Bypass in Superior Vena Caval Obstruction John F Higginson[1] (Portland, Ore) treated 1 patient with benign obstruction of the superior vena cava by resection of the innominate veins and superi-

(9) Ann Surg 145 254 257 February 1957
(1) J Thoracic Surg 32 684-690 November 1956

or vena cava, with substitution of an aortic-iliac bifurcation homograft, and 2 patients with malignant obstruction of the superior vena cava by establishing an aortic homograft shunt between the left innominate vein and right auricular appendage.

CASE 1.—Man, 28, had superior vena cava obstruction for 2 months. X-rays showed a 3 cm. rounded mass in the right superior hilar area. Angiocardiograms showed constriction of the superior vena cava at its origin. Thoracotomy revealed a fixed mass cephalad to the hilus, anterior to the trachea, and encasing the right phrenic nerve, superior vena cava, distal azygos and distal innominate vein. As the mass was sharply dissected off the trachea, its posterior portion was found to be old, calcific, granulomatous and anthracotic lymph node material. An aortic-iliac bifurcation homograft (frozen dried) was placed upside down as the mass was removed with encased distal innominate veins and proximal superior vena cava. The proximal right innominate vein was anastomosed to one iliac limb of the homograft, and then the proximal left innominate vein and distal superior vena cava were clamped and divided and the specimen removed. The aortic end of the homograft was then anastomosed to the distal superior vena cava stump, the homograft was filled with a dilute heparin solution, the other iliac limb was clamped, and venous return reestablished via the right innominate vein and homograft and superior vena cava stump. The third anastomosis was then done. There was immediate improvement of the patient's cyanosis and edema. Bilateral simultaneous angiograms, 11 months postoperatively, demonstrated patency of the graft and perhaps a slight increase in narrowing of the lumen of the homograft. The patient was clinically well.

CASE 2.—Man, 53, had a 2 weeks' established superior vena cava obstruction preceded by cough for 6 months. X-rays showed a right superior mediastinal mass. Thoracotomy revealed a mass in which the azygos vein was buried and the superior vena cava grossly involved. Biopsy showed metastatic carcinoma. A reconstituted frozen dried aortic homograft was anastomosed to the right auricular appendage following partial amputation. Incision of the left innominate vein revealed a thrombus, but with release of the proximal vein, the blood flow pushed it out and the homograft was then anastomosed to the side of the left innominate vein. The right innominate vein was obstructed by tumor proximally. Immediate satisfactory flow followed removal of clamps and the venous pressure was immediately altered. The patient was given deep x-ray therapy postoperatively and did well, but he died 4½ months after operation.

Autopsy showed that the left innominate vein, homograft and right auricular appendage were patent, but there was a striking change in the homograft. Its wall was wrinkled, sclerotic, contracted, and there were subintimal calcific plaques in it. Proximally, there was a thin veil of mural thrombus The calcification was in areas of necrosis

which had occurred subintimally and in the adjacent portion of the media Elastic tissue of the media was condensed and decreased as shown by elastic tissue stains The intima was thickened by fibro cellular proliferation If the patient had lived long enough the changes in the homograft might have eventually resulted in obstruction to blood flow

CASE 3—Man, 30, who had a fibrosarcoma removed from the soft tissues of the right thigh 7 years before, had a superior vena cava obstruction which was once relieved by exploration and decompres sion The second time, a shunt was established between the right *auricular appendage and the side of the left innominate vein by* an aortic homograft Complete relief of superior vena cava obstruction was obtained, but a few months later the syndrome recurred

Autopsy showed the innominate vein, homograft and right auricu lar appendage were patent with no evidence of thrombosis The aortic homograft grossly showed some wrinkling, but microscopically it could not be distinguished from a normal aorta even by various stains However, there was some beginning proliferation of fibrous tissue along the intima of the graft from the points of anastomosis

New Method of Surgical Treatment of Blood Vessel Le sions is reported by P I Androsov[2] (Skliosovsky Inst, Moscow) Vascular sutures are infrequently applied in surgi cal treatment of blood vessel lesions because they are difficult to perform and because of frequent thrombosis at the site of application These shortcomings are eliminated by a mechan ical method which permits automatic application of faultless vascular sutures Androsov and associates developed an ap paratus which applies a circular suture on vessels 1 3-15 mm in diameter, with consideration for the various thicknesses of the walls Suturing of blood vessels is by means of inverted U-shaped clips *with pointed ends The clips are of round* tantalum wire, 100 200μ in diameter, depending on the di ameter of the vessel to be sutured and the thickness of the walls Suturing of injured blood vessels by the apparatus is simple and within reach of the ordinary surgeon

METHOD—Ends of injured vessels, 1 5 2 cm long, are isolated from surrounding tissue, following which the hemostatic clamps of the apparatus are applied to the isolated ends The vessel is then fastened by the semibushings of the instrument The ends of the vessel are turned inside out with the intima outside on the bushing of the in strument as a cup (this is done with the help of two anatomic eye pincets) and is fastened in this position by the jaws of the cup clamp After fastening the vessel on the bushings, the left and right parts of the instrument are joined and locked by a connecting plank The in

(2) A M A Arch Surg 73 902 910 December 1956

turns of the vessel ends then closely adhere to one another The vessel is sutured in less than a second by pressing the lever The latter drives the tantalum clips, located in the semibushings of the clipping part of the instrument, into the tissue of the folded ends of the vessel On their way the clips run through both walls of the vessel and rest against the hole of the supporting part of the instrument The legs of the clip, each getting into its respective hole, are bent to a B-shape, which ensures an airtight and firm connection of the vessel ends

A vessel-suturing one-clip apparatus was also constructed to apply longitudinal sutures on blood vessels The procedure is started by applying a tourniquet above the lesion, followed by a primary treatment of the wound The injured vessel is detected If there is a mural (less than a third of its circumference) or longitudinal lesion of the vessel,
one clip apparatus, regardless of
the defect of the vessel wall pre-
, it is best to cut the vessel completely at the lesion, isolate its ends from the surrounding tissue, refresh it turn it inside out on the bushings of the apparatus, and apply a circular suture

The author also applied the vessel-suturing apparatus in surgical management of traumatic aneurysms End-to end suturing of a vessel by the apparatus is possible only when the gap between the ends equals 3-3 5 cm When the defect is greater, a plastic operation on the vessel is indicated

► [This ingenious mechanical device for blood vessel suture is similar in
ximately a
The basic
and con
sists in the use of a small cannula, ring or tube through which one end of the vessel is threaded and cuffed back, thus exposing the intima The other end of the vessel is then drawn over the cannulated vessel and tied thus completing the anastomosis and establishing continuous intimal contact In 1907 Crile used this principle in developing his direct method of blood transfusion and during the next few years numerous modifications of this method were proposed for the purpose of both direct blood transfusion and blood vessel anastomosis Among these the method developed by Soresi (New York J Med 93 622, 1911) is of particular historical interest because of its similarity to the vessel suturing apparatus of Androsov Although Soresi's instrument was much simpler in design, it accomplished the same purpose and was used in much the same way Perhaps the most notable difference was that Soresi used gold instead of tantalum wire to fasten the ends of the vessels

Ingenious as they may be, such devices have generally proved of little practical value To be sure, they can be used successfully in the experimental animal with normal vessels and even in humans in relatively normal peripheral vessels, but their application in most clinical cases requiring suture anastomosis is simply impractical and in many instances impossible It is safe to predict that Androsov s instrument is doomed to the fate of its historical predecessors —Ed]

Effect of Heparinization on Vascular Healing was studied by Felix Bacigalupo, Erwin Simandl, Shivaji B Bhonslay and Ralph A Deterling Jr[3] (Columbia Univ) in 21 dogs in which suture anastomoses of the abdominal aorta were performed There were variations in mode of administration of heparin and in time relation to performance of the anastomosis There was no postoperative bleeding from the suture line, and study of the aorta during intervals to 12 weeks after operation revealed no impairment of tensile strength or abnormality in healing of the anastomosis No hematoma developed, and wound healing was satisfactory

In a selected series of 6 patients with a bypass graft of the superficial femoral artery, heparinization was begun immediately after re-establishment of blood flow through the graft The decision to use anticoagulant therapy was based on presence of moderate or advanced arteriosclerotic degeneration of the artery adjacent to the occluded segment as well as difficulty in performing technically satisfactory anastomoses

None of these 6 patients had leakage from anastomoses or significant hematoma in the operative area or wound In all venous clotting time was kept in a therapeutic range from time of operation until heparin was stopped In general, after heparin was administered initially, it was given by deep subcutaneous injection 40 75 mg every 4 6 hours Two to 4 days after operation, bishydroxycoumarin (Dicumarol®) was given orally to some patients in a dose of 300 mg, followed by 150 200 mg the next day Thereafter, the dose was adjusted according to daily prothrombin time Heparin was discontinued after the first week in these patients In others heparin alone was used for the entire course Complete satisfactory function of the graft persisted in all but 1 patient In this instance failure of function of the homograft developed before heparinization It is believed that anticoagulation prevented propagation of the fresh thrombus into the distal arterial segment and contributed to continued success during healing after a second operation, especially in view of the markedly calcified and atheromatous vessel

The authors caution against use of any anticoagulants in patients with hepatic or renal disease, blood dyscrasias ul

(3) A M A Arch Surg 74 153 172 February 1957

cerated areas or gastrointestinal or renal bleeding Since functional results with grafts have been least satisfactory in smaller arteries, it is expected that the widest use of immediate postoperative anticoagulation will be in patients with occlusive peripheral vascular disease

► [The impression given by the authors of this article that anticoagulant therapy was a significant factor contributing to the successful results obtained in this small experience does not seem justified by close analysis of their cases In 3 of the cases, for example, occlusion occurred after the first operation despite the use of anticoagulants, and a second operation was necessary before success was achieved In another with bilateral femoral occlusion, a bypass graft on the left restored pedal pulses, but on the right the bypass graft was unsuccessful Significantly, anticoagulant therapy was not used in the former instance but was in the latter In still another case with bilateral femoral occlusions, the bypass graft was successful on one side but not on the other Thus of 10 operations in which anticoagulant therapy was employed, successful results were obtained in only 5 Larger experience, including our own, has clearly demonstrated a much higher success rate without the use of anticoagulant therapy The most important factor in successful application of these procedures is provision of an unimpeded flow into the distal arterial bed As emphasized by Shaw in one of the following articles in this section, when this objective is achieved, anticoagulants are unnecessary, and conversely, when this is not achieved anticoagulants simply cannot be expected to take the place of a good operation —Ed]

Emergency Management of Wounds of Large Blood Vessels. Harris B Shumacker, Jr[4] (Indiana Univ) states that blood volume should be restored to normal as soon as possible, ideally with whole blood Sometimes bleeding ceases spontaneously, more likely in small than in large blood vessels Bleeding from veins is more apt to stop than bleeding from arteries The ends of the completely severed vessel may contract and thrombose, while the partially divided artery or vein tends to remain open Severe contusion of the damaged vessel or surrounding tissues favors cessation of bleeding

Sometimes as a temporary measure small vessels can be readily clamped with a hemostat This is dangerous in injuries to large blood vessels or those deep in a wound In some cases, a snug pressure dressing suffices At times, packing the wound directly with sterile gauze or a hemostatic material may be necessary Rarely should a tourniquet be required If the patient is in shock, narcotics should be administered intravenously Tetanus toxoid should be given or, in nonimmunized patients, tetanus antitoxin

Surgery must be carried out promptly when there is per-

(4) S Clin North America 36 1329 1335 October 1956

whom survived Except when resection and anastomosis were necessary to avoid luminal constriction or to excise a traumatized arterial wall, longitudinal and transverse lacerations were sutured If loss of substance or subintimal dissection made anastomosis impossible, the defect was bridged with an arterial homograft

Ligation was necessary in 32 patients Simple exploration without arteriotomy relieved compression from associated fracture in 1 and revealed severe arterial spasm in 3 Restitution of function with good pulses was achieved in 86% of the patients

Immediate repair of acute arterial injuries by simple suture, or resection and anastomosis, or homograft replacement, as indicated may be expected to produce excellent results

More Aggressive Approach toward Restoration of Blood Flow in Acute Arterial Insufficiency is recommended by Robert S Shaw[6] (Massachusetts Gen'l Hosp) Indications for embolectomy should be more liberal for two reasons (1) it may be applied to patients with extension of thrombus which can often be successfully removed and (2) the operation should be performed even in those in whom limb survival is not in doubt since the incidence of chronic ischemic symptoms in patients treated "successfully" without operation is high Early attempts at embolectomy were unsuccessful probably as much because the patients reported late and secondary thrombus was incompletely removed as because of inadequate technics in suturing and handling vessels Later successful experience was with early emboli in which secondary thrombosis had not occurred In late cases of peripheral embolism with extensive distal thrombosis retrograde flushing reinforced by direct milking of the vessel with the fingers has proved effective Fortunately for the success of efforts to remove distal thrombi the smaller branches of the thrombosed artery may not be invaded by clot Even where there is extension down the finer arterial branches, clot may sometimes be successfully removed A standard technic for popliteal embolectomy has been developed

(6) Surg Gynec & Obst 103 279 288 September 19[illegible]

TECHNIC.—The popliteal artery is exposed through a vertical incision in the popliteal space. A vertical popliteal arteriotomy is performed 2 or 3 cm. above the bifurcation and thrombus is drawn out of the artery by traction and by milking vessels upward from well below the popliteal bifurcation. The vessel is not clamped distally until the clot is evacuated. An over and over suture is more satisfactory than an everting stitch in closing the arteriotomy in a stiff sclerotic vessel. If the distal end of the removed clot is not blunt and smooth, suggesting that it has been broken, or if pedal pulses do not appear after re-establishment of flow, the vessel is flushed retrogradely from the posterior tibial artery at the ankle.

Arteriography on the operating table is useful in defining the presence or absence of thrombus in doubtful cases. Early popliteal emboli arising from the heart may present a simple technical problem. In 3 patients, 2, 5 and 8 hours after embolization, return of pedal pulses and an excellent result were accomplished without retrograde flush, but in 1 a popliteal arteriogram was required to show the absence of distal thrombus.

In most patients with degenerative arterial occlusive disease of the legs, the primary lesion appears to be atherosclerosis in the adductor canal region of the superficial femoral artery with secondary thrombosis, which may be limited in extent, leaving a segmental block in the lower superficial femoral artery with sufficient collateral circulation to the popliteal artery to preserve the limb. In some, however, distal propagation of clot will obstruct the popliteal and upper tibial arteries, with resulting serious ischemia. Results so far do not establish that acute thrombosis of the sclerotic femoral artery will be improved by evacuation of distal thrombus and restoration of continuity past the primary obstruction by arterial graft, although this is worthy of further consideration.

The key to successful reconstructive arterial surgery is the re-establishment of good flow through the manipulated artery, which implies an open distal arterial tree. Good flow is more important in preventing postoperative thrombosis than anticoagulant therapy. The latter is unnecessary where good flow is established and may be of no avail in preventing thrombosis when flow is poor.

The success of the application of an aggressive approach toward restoration of blood flow in a few patients indicates

that, certainly with embolism and possibly with all acute arterial occlusion, restoration of normal vascular anatomy should be the first objective and therapy with anticoagulants and sympathetic blocks should be ancillary Time is important, and the best results will be had from prompt restoration of circulation before serious ischemic damage and propagation of distal thrombus has occurred

► [The aggressive approach advocated by Shaw and the gratifying results obtained by him as well as others who have accepted this attitude deserve much emphasis and wider adoption —Ed]

Retrograde Flush Procedure in Embolectomy and Thrombectomy, designed to overcome the problems of distal thromboses and constriction and spasm in small arteries, was used by E Stanley Crawford and Michael E De Bakey[7] (Houston) in 11 patients

For a small embolus in a small peripheral artery, the incision is made in a segment above the embolus where the artery is large enough to permit repair without inviting local thrombosis The embolus is flushed backward with saline solution injected into the artery distal to the embolus (Fig 53) An embolus from a larger artery and the distal thrombus may be similarly removed, and thrombi distal to arterial operations are flushed out through proximal arteriotomies in the same manner

This retrograde flush procedure was used for 6 emboli 3 intraoperative thrombi, 1 thrombosed popliteal aneurysm with thrombi distal and proximal to the primary lesion and 1 thrombus distal to a graft that thrombosed because of pressure from a hematoma Thrombosis was also associated with 4 cases of embolism which was present 18 hours to 5 days before operation Normal circulation was completely restored and amputation prevented in 10 of the 12 extremities involved Pedal pulses reappeared in another patient after removal of a femoral arterial embolus and distal thrombus, but gangrenous changes had already occurred Amputation was done because of progressive necrosis of the calf muscle failure of regression of gangrene pain and infection The second failure occurred in a patient with a femoral embolus and distal thrombosis for which retrograde flush removal was unsuccessful because of coexisting arteriosclerotic occlusion

(7) Surgery 40 737 746 October 1956

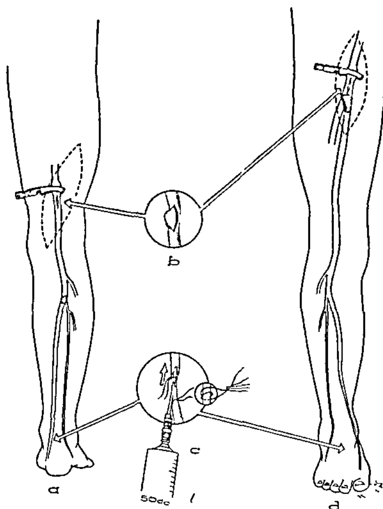


Fig 53—*a*, embolus obstructing distal popliteal artery, *d* embolus and its "tail clot" obstructing femoral artery Bleeding has been controlled by atraumatic clamps and short vertical incisions made distal to clamps (*a* and *d*) Beaded cannula has been inserted (*c*) in posterior tibial artery behind internal malleolus (*a* and *d*). A 50 cc. syringe containing warm saline is used forcefully to inject through cannula, *b*, rest of clot is flushed out of arteriotomy in upper wound (Courtesy of Crawford, E. S, and De Bakey, M E Surgery 40 737 746, October, 1956)

in the calf arteries The only two limitations of this maneuver, therefore, are a previously occluded vessel between the cannula and the embolus or thrombus and a nonviable part distal to the embolus.

Consideration of 94 Peripheral Arterial Emboli in 72 patients (37 women) is presented by R. Fontaine, M. Kim and R. Kieny[8] (Strasbourg) Fourteen had 2 simultaneous or re-

(8) Lyon chir 51 655 678, Nov Dec, 1956

curring embolisms and 4 had 3 All ages were represented, but 41 patients were 50-70 The source of embolism was acute endocarditis in 3, valvular disease in 45 (64 9%), myocardial infarct in 10, arterial aneurysm in 4, paradoxical embolism with venous thrombosis in 2 In 8, the source was undetermined

Of 38 patients examined before the 10th hour, embolectomy was done on 28 of 32 with total ischemia and on 1 of 6 with relative ischemia Of 56 seen after the 10th hour, embolectomy was done on 12 of 17 with total ischemia, on 5 of 25 with relative ischemia and on 6 of 14 with gangrene In 12 patients, embolectomy was not possible Four of these were treated by lumbar sympathectomy, 4 by arteriectomy, 1 by a fresh venous autograft for relative ischemia and 3 by arteriovenous shunts Four had immediate amputation

Among 26 patients treated medically, 4 died and 2 required secondary amputation In 20, the extremity was saved, but with impermeable arteries Of 29 having embolectomy before the 10th hour, secondary amputation was required in 2 Vascular permeability was restored in 18 and remained absent in 8 Among 12 patients seen after the 10th hour subjected to embolectomy for acute ischemia, 2 died and 4 had secondary amputations Of 6 in whom the extremity was saved, vascular permeability was restored in 2 Of 5 embolectomized patients with circulatory deficiency, 1 died and 1 required secondary amputation In 1 of 3 whose legs were saved, vascular permeability was proved Secondary amputation was required in all 6 embolectomized patients who developed gangrene Of 12 having lumbar sympathectomy or other procedures, 3 required secondary amputation, but the artery remained nonpermeable in all 9 whose limbs were saved

It might appear that medical treatment is superior to embolectomy, since limbs were conserved in 76 9%, although this was possible in only 68 2% of those having embolectomy Medical treatment was limited to patients with the most benign cases and embolectomy permitted re establishment of vascular permeability in 22 (19 of 29 operated on before the 10th hour), whereas in all patients treated medically, the artery was obliterated Four patients requiring immediate amputation had been treated by anticoagulants before enter-

ing the hospital, so should be regarded as failures of medical treatment Four deaths occurred among 26 patients treated medically and only 3 among 52 who had embolectomy Superiority of surgical treatment is evident when results of embolectomy before and after the 10th hour are compared In 29 operated on early, the limbs were conserved in 93 1% with re-establishment of vascular permeability in 65 5%, and no deaths After the 10th hour, there were 3 deaths, with limbs conserved in 39 1% and arterial permeability restored in 13% Despite large doses of anticoagulants, 11 patients seen after the 10th hour developed venous thromboses of the thrombophlebitic type, 5 during conservative treatment, 5 after embolectomy and 1 after lumbar sympathectomy Many patients were seriously handicapped because of their primary disease Peripheral embolism, however is not necessarily a complication of the terminal stage of cardiac and vascular disease and many patients cured of this complication survive for a long period

Of 4 patients operated on for mitral stenoses, 3 had had a single arterial embolism and 1, several cerebral and peripheral emboli, all 4 cardiac operations were successful, without subsequent embolic complication The authors believe that an arterial embolism constitutes an indication, rather than a contraindication, for mitral commissurotomy Intracardiac thrombosis following an infarct can, in itself, constitute the indication for cardiac surgery

Arterial Embolism Harris B Shumacker, Jr, and Herbert S Jacobson[9] (Indiana Univ) reviewed their experiences with arterial embolism to the aorta and peripheral arteries excluding those to the brain and viscera, over a period of about 8 years The study includes 55 patients with 65 ischemic limbs

Results in patients not treated by direct arterial surgery were poor, with 4 deaths among 21 patients (19%) Amputation was required in 13 of the 26 affected extremities Good results from sympathetic denervation were achieved in 2 patients with impaired circulation but viable extremities after embolism

In the group treated by arterial surgery, the results were

(9) Ann Surg 145 145 157 February 1957

better The mortality was no higher than in the other group, 7 deaths having occurred among 34 patients (20 5%) Circulation was adequately restored in 31 of 39 ischemic extremities In both groups the mortality seemed related to the underlying disease and age of the patients, being about twice as high in those over 60 than under Mortality was relatively low in patients with rheumatic heart disease and considerably higher in those with myocardial infarction, arteriosclerotic heart disease and hypertensive cardiovascular disease Embolism to the main arteries of the upper extremity is not innocuous and patients cannot be neglected under the false, optimistic impression that the affected extremities are almost certain to survive if provided adequate circulation

Embolectomy is relatively simple and not attended by any significant risk per se The earlier it is done after embolism, the better the results Survival of the limb is primarily dependent, however, not on the time interval between embolism and operation, but on the presence or absence of propagated thrombus in the distal arterial tree The passage of relatively long periods after embolism does not signify that embolectomy will fail Excellent restoration of circulation can be achieved if it is done as late as 48 hours after embolism When patients with impaired circulation but still viable extremities are treated much later, bypass grafting procedures may prove superior to embolectomy

Operative Treatment of Sudden Occlusions of Popliteal Artery, although in an occasional patient no significant deficit occurs from sudden popliteal occlusion, most patients will suffer from claudication Brooke Roberts and Charles Davis[1] (Univ of Pennsylvania) believe that immediate operation should be done in most patients and an attempt made to relieve the obstruction With modern technics and use of heparin a significant proportion of these occlusions can be overcome in the others, the situation is seldom made worse

Popliteal arterial emboli and acute thromboses are readily suspected when there is sudden pain, loss of distal pulses, prompt cooling of the part, with a pale or mottled foot, together with anesthesia or loss of voluntary motion of the toes However a popliteal pulse may be palpable in a patient

(1) Am Surg 145 544 551 April 1957

with an embolus lodged in the lower portion of that art Changes in skin color and temperature are likely to oc between the calf and the malleoli Some patients do not h pain, only some loss of sensation and cooling of the foot others, onset may suggest phlebitis on superficial exam tion because of tenderness in the calf An oscillometer i help in determining the level of occlusion Often, the stat the peripheral pulses before the occlusion is unkno then the findings of acute ischemia and the history mus relied on The prior ability to use the limb will give some dication of its previous blood supply Arteriography Hypaque® sodium, which carries minimal risk, may hel localization

The authors operated on 5 men and 2 women, aged 41 Results were excellent in 3 and fair in 20 In the 2 pati who died, the operation did not appear to contribute ma ally to death In 6 instances, the pulse was restored to involved foot, but in 2 it subsequently disappeared again

Use of Autologous Venous Grafts in Peripheral Art System Jere W Lord Jr and Peter W Stone[7] (New Y Univ) inserted 21 autologous venous grafts into the per eral arterial tree The procedure was used in 5 patients arterial injury, 6 with arterial aneurysm or arteriovenous tula and 1 in whom resection of a malignancy of the tl necessitated sacrifice of the common and superficial fem arteries These 12 grafts have remained patent, and the lo est follow up has been 7 years No aneurysm of any of grafts has been noted Use of autologous venous graft treatment of segmental obliterative arterial disease has l less satisfactory Direct interposition of a venous graft fa in 1, and use of the bypass principle has been successfu only 4 of 8 patients These patients have been followed briefly, and perhaps late thrombosis may reduce the nun of successful cases

This series indicates that autologous venous grafts f tion well when introduced into a peripheral arterial sys in which the distal arterial tree is patent and there is nc terference with the arterial runoff This graft, because o

dom from potential antigenicity, seems to be the most satisfactory for restoration of peripheral arterial continuity Failure of the autologous venous graft in segmental obliterative disease of the peripheral arteries is thought due more to the disease than to inherent deficiencies in the graft

► [Autologous venous grafts may be satisfactorily employed for the replacement of relatively short discrete segments of peripheral arteries, particularly following trauma, as demonstrated by these surgeons In arteriosclerotic occlusive disease, however, in which graft replacement of much greater length is usually required, experience has shown that autologous venous grafts are not so satisfactory as arterial homografts or plastic tubes —Ed]

Structural Alterations in Human Aortic Homografts 1-2½ Years after Transplantation Oscar Creech Jr Michael E De Bakey, Denton A Cooley and Bela Halpert[3] (Houston) did gross and microscopic studies on 4 human aortic homografts 14, 24 28 and 30 months after transplantation They found that the human aortic homograft becomes functionally and structurally adapted to its new environment Structural changes occur gradually and consist of retention of the media and formation of a new intima and a new adventitia The intimal surface of the homograft is not covered by a continuous endothelial lining Near suture lines and for varying distances toward the midportion of the graft, the intima is cellular In parts, an amorphous fibrinoid substance covers the surface, elsewhere the fibers of the media border the inner surface The media is narrowed by condensation of the elastic fibers and apparent loss of its ground substance On the outside, the vessel wall becomes fortified by hyalinizing fibrous connective tissue that forms a new adventitia

The arterial homograft is not replaced by scar tissue The homograft retains much of its architectural pattern while it is being reinforced by fibrous connective tissue of the host

In the grafts 14, 24 and 28 months old, some changes were noted in the media that did not appear in grafts implanted for shorter periods The changes consisted of focal fragmentation of elastic fibers and disruption of them by cholesterol clefts and scattered deposits of calcium apparently an atherosclerotic process These changes however, were not seen in the graft examined 30 months after transplantation (Fig 54)

These structural changes occurring in the graft apparent

(3) Surg Gynec & Obst 103 147 154 August 1956

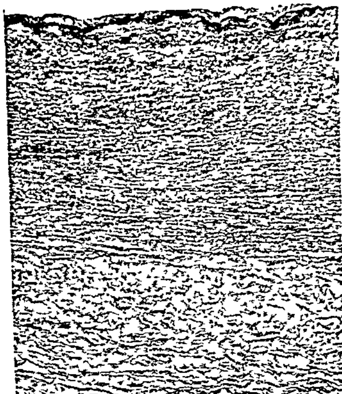


Fig. 54—Abdominal aortic homograft 30 months after transplantation In mid portion of graft, intimal surface is bordered by closely packed elastic fibers Elastic fibers of media are intact Weigert preparation; reduced from ×40 (Courtesy of Creech, O, Jr., *et al*: Surg, Gynec & Obst. 103 147-154, August, 1956)

ly are not related to the function of the homograft. Thus, in more than 400 cases of aortic resection and homograft replacement covering a follow-up period of 3½ years, the grafts have continued to function satisfactorily.

Freeze-Dried and Alcohol-Preserved Homografts for Replacement of Small Arteries. Rapid advances in vascular surgery in recent years have increased markedly the demand for arterial substitutes Tubes from anatomic structures, in a fresh or preserved state, and those constructed from a number of synthetic plastic materials have been used most frequently in laboratory and clinical studies. Although freeze-dried arterial homografts and plastic grafts are popular, more study will be required to evaluate properly the suitability of various substitutes and means of preservation currently in use.

Thomas C. Moore, Angelo Riberi and Hisashi Kajikuri[4]

(4) Surg, Gynec & Obst 103 155 162 August 1956

(Indiana Univ) used 111 freeze-dried and alcohol-preserved arterial homografts to replace small caliber arteries in dogs Dog carotid artery was used as homograft material in all replacements for both femoral and carotid arteries The grafts averaged 5 cm in length Anticoagulants were not used Sixty-one grafts (55%) remained patent and functioned satisfactorily In 57 carotid artery replacements, 61% patency was achieved, compared with a patency of 48% in 54 femoral grafts Thrombotic occlusion of the graft at time of grafting occurred frequently, which suggests that occlusion of most grafts occurs relatively soon after placement Alterations in the technic of graft preparation and placement may lead to improved results

Small caliber arterial homografts preserved in 70% ethyl alcohol were found to be at least as satisfactory as the freeze-dried grafts

Vascular Prostheses· Report of Committee for Study of *Vascular Prostheses of Society for Vascular Surgery* Oscar Creech, Jr , Ralph A Deterling Jr , Sterling Edwards Ormand C Julian, Robert R Linton and Harris Shumacker, Jr [5] found that vascular prostheses made of synthetic materials may be used effectively as aortic replacements The reported 93% successful results in 256 cases compare favorably with experience with homografts From a functional standpoint, synthetic vascular substitutes appear to be as satisfactory as homografts Similarly acceptance of these materials by recipient tissues is little different from that observed with homografts i e both produce a moderate inflammatory reaction and eventually become incorporated into recipient tissues largely by growth of fibrous connective tissue

The ultimate morphologic appearance of synthetic prostheses or homografts has not yet been determined but from a few observations made at 2 years, degenerative changes appear more likely to develop in homografts Synthetic prostheses are more difficult to use technically, are less adaptable to varying aortic diameters than homografts and bleed momentarily until clotting occurs in the interstices This bleeding may constitute a serious problem, as indicated by a report

(5) Surgery 41 62 80 January 1957

of 2 deaths from uncontrollable hemorrhage through the walls of the prostheses

The most satisfactory materials are Dacron and Teflon

► [A recent analysis of our experience with 317 cases of aortic and arterial diseases in which vascular prostheses were used has led us to the conviction that with further improvements in the fabrication and design of these materials they should completely replace human tissue —Ed]

Flexible Aortic Bifurcation Graft of Chemically Treated Nylon W Sterling Edwards and James S Tapp[6] successfully by-passed in 4 patients the aortic bifurcation obstruction from arteriosclerosis with a new braided Y tube of Nylon

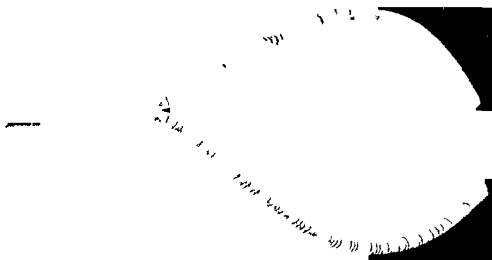


Fig 55 —Braided Nylon bifurcation graft treated with formic acid to make noncollapsible tube (Courtesy of Edwards W S and Tapp J S Surgery 41 723 728 May 1957)

treated chemically with formic acid (Fig 55) One ruptured abdominal aortic aneurysm was replaced with this graft, but the patient died of pre existing shock

This prefabricated graft is easily sterilized and sutured, and has a low incidence of early thrombosis Its chief advantage over tailored fabric Y tubes is its noncollapsible and nonkinking characteristic The valuable bypass technic has been difficult to accomplish with flat collapsible tubes because of the likelihood of wrinkle obstruction Whether Nylon has any long-term superiority over other synthetic fibers is not yet known, but its reaction in animals and man has

(6) Surgery 41 723 728 May 1957

been studied far more than have other fibers Nylon certainly appears durable and inert, and further chemical modification should allow grafts to have all the favorable characteristics of homografts without the unfavorable factors of difficult procurement and occasional degeneration

Use of Artificial Fiber as Artery Substitute Paul W Sanger, Frederick H Taylor, Takuro Matsuba and Frank Salo mone[7] (Charlotte, N C) used knitted, seamless Orlon and Nylon tubes to replace 3 5 cm of thoracic aorta in 83 dogs Properties of knitted Orlon and Nylon grafts are not lost after sterilization in steam autoclaves or by boiling, have satisfactory porosity, are nonirritating and resistant to deterioration in the body, remain strong when wet, and resist

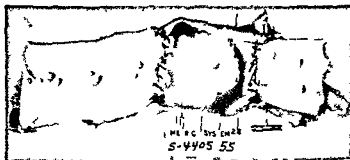


Fig 56 Graft removed 18 months after insertion showing complete covering by glistening intima (Courtesy of Sanger P W *et al* Ann Surg 143 862 867 June 1956)

deformity and stretch Hypothermia was used so the aorta could be clamped for long periods without ischemic damage to the spinal cord The anastomosis was done with continuous over and over 4 0 arterial silk sutures Autopsies were done from a few weeks to 18 months after operation Examinations of the grafts, grossly and microscopically showed a smooth, fibrous tissue layer outside and inside the lumen (Fig 56) with growth of fibrous tissue through the interstices of the graft Aortograms at varying intervals postoperatively showed patent grafts without dilatation or significant constriction

Knitted seamless Orlon fabrics have been used successfully as arterial grafts at various levels of the aorta and iliac arteries by 24 surgeons on 78 patients Knitted Orlon or Nylon

(7) Ann Surg 143 862 867 June 1956

is a satisfactory prosthesis for such vessels, but smaller arteries cannot be treated in the same manner Teflon, a new synthetic fabric, may be useful for these It has little resistance to blood flow, permits negligible seepage of blood and induces minimal clotting

Effect of Chronic Hypercholesterolemia on Synthetic Aortic Substitutes Oscar Creech, Jr , George L Jordan, Jr , and Michael E De Bakey[8] (Houston) found that synthetic aortic substitutes made of Nylon and Orlon, unlike aortic homografts, did not result in atherosclerotic lesions even when the adjacent aorta was involved Although a severe degree of hypercholesterolemia (in excess of 1,000 mg/100 ml) was maintained for 13 months and the natural arteries showed abundant atheroma formation, atheromatous change in the prostheses was not evident However, atheromas occurred at the proximal anastomosis sufficient to occlude the lumen This area represents a trauma zone especially prone to lipid deposition Similar changes at the lines of anastomosis have been observed in human aortic homografts The plaque-to-lumen ratio was great enough, however, to prevent interference with blood flow When synthetic tubes are used in smaller vessels, such as the femoral arteries in man or the abdominal aorta in dogs, development of atheromas at the lines of anastomosis may result in luminal occlusion

It is doubtful that longer periods of observation would produce any significant difference in the result, since, in most instances the connective tissue which had enveloped the prostheses was adult and the process of acceptance of this foreign material appeared to be stabilized

► [Perhaps the most significant finding derived from this study lies in the observation that lipid deposition and atheroma formation are especially prone to occur in zones of trauma This may indicate one of the causes for later failures in graft replacement procedures for arteriosclerotic occlusive disease and emphasizes the necessity for exercising great care precision and minimal trauma in performing these operations —Ed]

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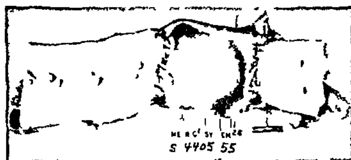


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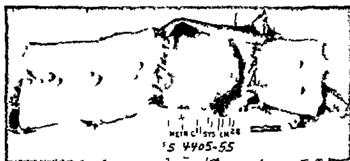


Fig. 56.—Graft removed 18 months after insertion, showing complete covering by glistening intima. (Courtesy of Sanger, P. W., *et al.*: Ann. Surg. 143: 862-867, June, 1956.)

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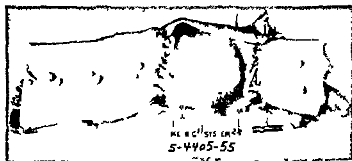


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(8) Surg., Gynec. & Obst. 104:385-389, April, 1957.
(9) J.A.M.A. 163:1102-1106, Mar. 30, 1957.

bacterial endocarditis Regardless of etiology, 5 major complications may arise, usually singly, but sometimes in combination Before the appearance of a complication, the aneurysm may be entirely asymptomatic and go unnoticed or, if recognized, may go untreated All asymptomatic popliteal aneurysms should be treated by surgery, unless it is strongly contraindicated Complications are pressure on the tibial and peroneal nerves, edema of the foot and leg due to partial occlusion of the popliteal vein total thrombosis of the aneurysm which may cause gangrene, rupture of the aneurysm, which also may cause gangrene hemorrhage and shock, and casting off of pieces of thrombus lining the inner wall of the aneurysm The pieces of thrombus act as emboli blocking the dorsalis pedis artery, and may cause gangrene of the toes or the entire foot

For therapy, several procedures are available, but the two most valuable are excision and endoaneurysmorrhaphy In patients who are fair or good risks with palpable pulses in the foot before onset of the complication, excision with insertion of a graft is the ideal procedure In poor risk patients or those in whom the pulse in the foot was absent before the complication, obliterative endoaneurysmorrhaphy is valuable

In 13 patients with 16 popliteal aneurysms, there was a total of 16 complications, only 2 aneurysms were asymptomatic Four aneurysms were treated by excision and vein grafting, with good results Twelve aneurysms were treated by obliterative endoaneurysmorrhaphy, and in all but 1 the extremity is intact and useful In this patient the limb was doomed 4 days before surgery by embolic episodes which blocked the origins of the anterior and posterior tibial arteries In selected patients, lumbar sympathectomy may be of considerable value

► [The author s recommendation of operative treatment for all popliteal aneurysms even though they may be asymptomatic unless strong contraindications to surgical intervention exist deserves emphasis His advocacy, however of excision with graft replacement only in patients who are considered fair or good operative risks or who have palpable pedal pulses and of obliterative endoaneurysmorrhaphy as the procedure of choice in those who are poor surgical risks or do not have palpable pedal pulses does not conform with our experience For one thing there can hardly be much difference in the operative risk between these two procedures For another

the absence of pedal pulses does not always signify occlusion of the distal arterial bed since we have observed a number of cases in which pedal pulses were restored after excision with graft replacement In some cases with acute thrombosis it has been possible to remove the thrombus from the distal arterial bed and re establish normal circulation Here again a more vigorous approach directed toward removal of the lesion and restoration of normal circulation can provide highly gratifying results Our experience has led us to the conviction that most of these patients can be treated by excision with graft replacement or in some instances with end to end anastomosis —Ed]

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Duration of symptoms was 24 hours to 35 years (average, 8 6 years) Principal manifestations were varices, lengthening and enlargement of affected limb (Fig 57), pain, vascular mass, stasis skin changes, ulceration and increased skin warmth

Only 34 patients had had no previous treatment, 35 had had 79 procedures performed elsewhere, consisting mainly of excision of vascular masses and varices and injection of sclerosing solutions Three had had x ray and 1 radium treatment for suspected malignant vascular neoplasm Two had had toe amputations for gangrene

Of the 69 patients, 28 were treated conservatively at their first visit to the clinic, while 41 had surgery or treatment with sclerosing agents Two had major amputations of upper limbs Of 53 patients followed an average of 7 6 years, 26 were re-examined Of these, 20 had 40 separate procedures including two major amputations an average of 2 8 years after first treatment Eight patients underwent amputations, 4 at the clinic, and major amputation was being contemplated for 3 others at time of follow up Seven of the 8 amputees had diffuse fistulas and 6 had evidence of fistulous process in one

(1) Angiology 7 201 217, June 1956

bacterial endocarditis Regardless of etiology, 5 major complications may arise, usually singly, but sometimes in combination Before the appearance of a complication, the aneurysm may be entirely asymptomatic and go unnoticed or, if recognized, may go untreated All asymptomatic popliteal aneurysms should be treated by surgery, unless it is strongly contraindicated Complications are pressure on the tibial and peroneal nerves, edema of the foot and leg due to partial occlusion of the popliteal vein, total thrombosis of the aneurysm which may cause gangrene, rupture of the aneurysm which also may cause gangrene, hemorrhage and shock, and casting off of pieces of thrombus lining the inner wall of the aneurysm The pieces of thrombus act as emboli blocking the dorsalis pedis artery, and may cause gangrene of the toes or the entire foot

For therapy several procedures are available but the two most valuable are excision and endoaneurysmorrhaphy In patients who are fair or good risks with palpable pulses in the foot before onset of the complication, excision with insertion of a graft is the ideal procedure In poor risk patients or those in whom the pulse in the foot was absent before the complication, obliterative endoaneurysmorrhaphy is valuable

In 13 patients with 16 popliteal aneurysms, there was a total of 16 complications, only 2 aneurysms were asymptomatic Four aneurysms were treated by excision and vein grafting, with good results Twelve aneurysms were treated by obliterative endoaneurysmorrhaphy, and in all but 1 the extremity is intact and useful In this patient the limb was doomed 4 days before surgery by embolic episodes which blocked the origins of the anterior and posterior tibial arteries In selected patients lumbar sympathectomy may be of considerable value

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(1) Angiology 7 201 217 June 1956

or more long bones In 2 with probable osseous involvement in the foot, recurrences developed after a direct attack on the subcutaneous fistulous mass

Only 5 of 69 patients had cardiac abnormality at time of first examination, and this was probably not related to the

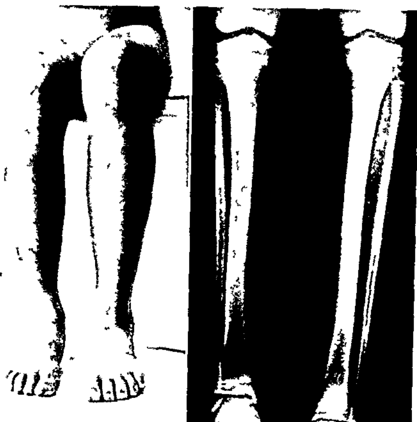


Fig 57 —Lengthening (3 5 cm) of left lower leg in girl aged 7 Fistulous communication involving femoral popliteal arterial junction was ligated and divided when patient was aged 9 At 13 left tibia was shortened by osteotomy At follow up patient 29 was in good general health but had ipsilateral varicosities and recurrent medial malleolar ulceration (Courtesy of Coursley G, *et al* Angiology 7 201 217, June 1956)

fistula No complaints referable to the heart developed in the 53 patients followed

Management of congenital arteriovenous fistulas in the extremities is difficult, as reflected in the large number of procedures performed Excision of localized fistulas often produces good results whereas it is difficult or even impossible to eradicate diffuse fistulas and still preserve the limb Associated involvement of bone results in recurrences of fis-

tulas after direct surgical attacks and frequently necessitates a major amputation of the affected limb Partial surgical excision may alter local hemodynamics so that actual or potential arteriovenous shunts open up at a more proximal level, giving rise to a recurrence which necessitates further surgery and often leads to loss of the limb because of inability to preserve function

Place of Direct Surgery in Treatment of Obliterative Arterial Disease is evaluated by Charles Rob[2] (St Mary's Hosp, London) Obliterative arterial disease may result from a variety of causes, including thrombosis after injury, coarctation of the aorta, thromboangiitis obliterans, an embolus or so called primary arterial thrombosis Direct surgery is the best treatment for coarctation of the aorta and thrombosis of a major artery after injury, it is a good treatment for primary thrombosis and some emboli, but only occasionally is possible in patients with thromboangiitis obliterans

In atherosclerosis, arterial reconstruction operations are best in patients with occlusions of the aorta and iliac arteries, and they are most gratifying in patients with gangrene of the toes and feet, cerebral symptoms due to partial internal carotid occlusion or hypertension Good results also follow reconstruction of the femoropopliteal artery in patients with intermittent claudication, but here selection is particularly important The bypass type of operation is best for occlusions of this vessel, but its reintroduction has not widened indications for surgery in patients with this general disease, unless the reason for operating is gangrene or rest pain

Reconstructive surgery is justified only when local manifestations of atherosclerosis predominate Fortunately, in a fair proportion of patients, atherosclerosis remains relatively localized, particularly in patients with occlusion of the abdominal aorta or iliac arteries and sometimes in those with thrombosis of the popliteal, femoral, carotid, mesenteric, renal and subclavian vessels The author estimated that at least 50% of patients with occlusion of the abdominal aorta and iliac arteries are suitable for a reconstruction operation, about 25% of those with femoropopliteal thromboses and

(2) Brit M J 2 1027-1029 Nov 3 1956

approximately 5% of those with internal carotid thrombosis

► [It is difficult to estimate accurately the proportion of patients with arteriosclerotic obliterative disease in whom arterial reconstruction operations may be successfully used owing to variations in statistical sampling As indicated in the following report however our experience would suggest that the figures reported by this author are much too low In occlusion of the abdominal aorta and iliac arteries for example the author estimates that about 50% are suitable for reconstruction operation whereas we have observed that this figure is approximately 95% Also in our experience this figure for occlusion of the superficial femoral artery is well over 50% instead of 25% as reported by Rob —Ed]

Arterial Homografts for Peripheral Arteriosclerotic Occlusive Disease Results of indirect methods of treating peripheral arterial insufficiency of the lower extremities have



Fig 58 —Arterial homograft inserted by end to side anastomosis to *A* left common femoral artery above and *B* popliteal artery below to bypass long occluded segment of superficial femoral artery *C* incisions used (Courtesy of De Bakey M E *et al* Circulation 15 21 30 January 1957)

been generally disappointing The response in a given case has been difficult to predict Rest pain and intermittent claudication are relieved infrequently Sympathectomy has offered little or no certainty against amputation for many manifestations of arterial insufficiency Arteriography of patients with chronic arterial insufficiency of the lower extremities has demonstrated that the occlusive lesion is localized and discrete with a patent vessel above and below it in most instances Consequently distal circulation may be restored im

mediately in most such patients by direct surgical means, thus assuring immediate relief of symptoms, healing of cutaneous lesions and prevention of amputation. Several methods of direct attack have been devised. The most consistently successful has been substitution of an arterial homograft for the obstructed segment. This may be accomplished by either of two technics. The occlusion may be completely excised and replaced by a graft, or a graft can be used to bypass the occlusion by suturing the graft end-to-side both above and

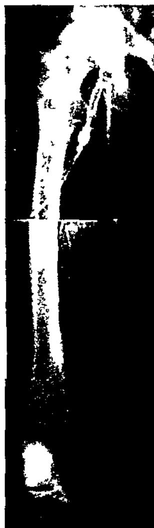


Fig 59—Right femoral arteriogram after operation showing functioning end-to-side bypass graft Note lack of disturbance to obstructed host artery and its collateral vessels (Courtesy of De Bakey, M F, *et al* Circulation 15 21 30, January, 1957)

below the occlusion In the early phases of their study, Michael E De Bakey, E Stanley Crawford, Oscar Creech, Jr, and Denton A Cooley[3] (Houston) used the former method in short discrete lesions and the latter for longer occlusive segments More recently and because it has proved superior, end-to side bypass has been used almost exclusively

The authors used this technic in 145 extremities for occlusion, 79 of which involved the iliac and 66 the femoral artery Excision and grafting were performed in 30 extremities, 18 with iliac and 12 with femoral arterial occlusion The bypass procedure (Figs 58 and 59) was used in 115 extremities, 61 of which had iliac and 54 femoral arterial occlusion A pulsatile blood flow distal to the occlusion was successfully restored, and all symptoms were relieved in 90% About 15 20% of these patients were candidates for immediate or early amputation This was prevented in all but 1 patient, whose foot had been destroyed before operation There were 2 hospital deaths from coronary thrombosis, and 2 low thigh amputations were required after failure of excision and grafting The circulation was not affected in any of the 11 patients in whom the bypass was unsuccessful

The authors believe that this form of therapy is applicable in most patients with arteriosclerotic arterial insufficiency of the lower extremities Among all patients examined by them and found on arteriography to have iliac occlusion, virtually all proved to be candidates for operation, with successful results in 93% Well over half the patients with femoral occlusions were found to be candidates for operation, with successful results in 87%

Evaluation of Thrombendarterectomy for Arteriosclerosis Obliterans of Femoral Artery Richard Warren[4] (Boston) reports his experiences in 19 extremities with femoral thrombendarterectomy, using stripping after the manner of Cannon and Barker Of 14 patients in whom the technic could be successfully completed and conditions were favorable for patency 12 (85 6%) left the hospital with open segments In 2, the reconstructed areas closed later (2 and 6 months), making a 31% total closure rate, but only a 16 6% 'later clo-

(3) Circulation 15 21 30 January 1957
(4) Surg Gynec & Obst 104 571 578 May 1957

sure rate' in patients who left the hospital with open segments The latter figures must be considered temporary because of the varying and short follow up

TECHNIC—A choice is made between two possible operative positions If the block starts near the origin of the deep femoral artery and extends to or below the femoral condyle the patient must be operated on in a position that allows approach to the front and back of the lower extremity For this, the authors rotated the pelvis partially If the lower end of the block is above the femoral condyles, the same

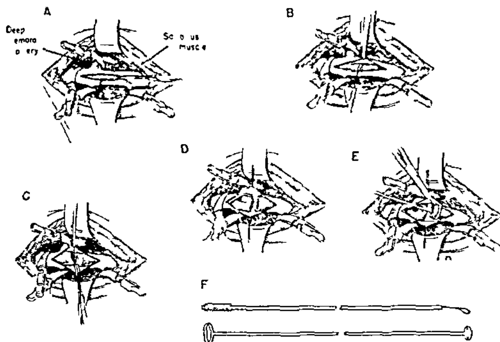


Fig 60—Management of upper arteriotomy *A* incision *B* preliminary dissection of core *C* division of core *D* upper intima trimmed *E* insertion of stripper *F* 2 types of strippers (Courtesy of Warren R Surg Gynec & Obst 104 571 578 May 1957)

position is used but the lowermost incision can be made just above the femoral condyles on the medial surface of the thigh Under these circumstances preparing for a possible posterior popliteal incision does no harm and gives considerable freedom when operative findings indicate a more extensive procedure If the upper end of the block starts at or below the middle of Hunter's canal, the patient may be operated on while semiprone with the affected leg placed inferiorly the other leg is flexed at the hip and out of the way This position affords approach to the medial thigh and popliteal space without rotation of the patient

When the arterial core can be removed through 2 incisions only 2 skin incisions need be made If another incision is necessary in the

artery midway between the initial 2, a long skin incision over the whole course of the artery may be wise

One artery was operated on through 1 long incision, 11 through 2 short incisions, 2 through 3 short incisions and 5 through 4 short incisions The number of incisions is in proportion to the difficulty of stripping, which varies from patient to patient It is better to make several incisions in the artery than to strip with excessive force The method for making the incision is shown in Figure 60

Thrombendarterectomy is technically best suited to short blocks without heavy calcification and under such circumstances may be considered as an alternate to reconstruction by the bypass technic

Rate of Blood Flow in Foot and Calf before and after Reconstruction by Arterial Grafting of Occluded Main Artery to Lower Limb P Gaskell (St Thomas's Hosp Med School, London) studied plethysmographically 11 patients with arterial occlusion involving a lower extremity before and after the occluded segment was replaced by an arterial homograft

Of the three plethysmographic tests used before operation, the degree of arterial occlusion was best indicated by impaired reactive hyperemia blood flow in the foot or calf and by reduction in the arterial cuff occlusion pressure The latter gave the simplest single reliable index of arterial occlusion The maximum resting blood flow was a poor index of vascular insufficiency, in the calf it was often greater on the occluded side than in the control limb, and in the foot it was usually not reduced enough to be decisive

After operation, the tests indicated at least temporary success in restoring adequate blood supply to the limb A prominent early postoperative feature was marked hyperemia in *the foot which subsided in about four weeks* This did not occur in every patient and was probably related to the degree and duration of vascular insufficiency Two years after surgery, 3 patients were maintaining adequate blood supply to the limb and 2 were much improved, in 6 patients, arterial occlusion redeveloped

(5) Clin Sc 15 259 269 May 1956

Management of Acute Massive Venous Occlusion is considered by John A Rasmussen, Stanley E Potter and R Russell Best[6] (Univ. of Nebraska) Usually, onset is rapid and dramatic, with severe pain, rapidly appearing edema and a mottled, violaceous cyanosis In about two thirds of the patients the arterial pulsation in the area of involvement is absent The etiology is not yet clearly understood The process is known to follow surgery for various disorders, trauma, visceral malignancy, pulmonary disease and cardiac disorders In a few patients there is no known associated factor Massive interference in venous return appears to be fundamental to the process The extent and ramifications of the disease depend on the addition of arterial and venous spasm The progressive nature of the disease in some patients cannot be ignored

Thrombectomy offers rapid, dramatic improvement in some instances Reopening significant venous channels after removal of large clots seems to alter more favorably the pathologic anatomy, in addition, there is less likelihood of a major embolus

The level of ligation should vary wtih the patient If emboli occur, ligation of the femoral vein may be combined with that of the inferior vena cava If the disease is limited to massive venous occlusion, ligation of the superficial femoral vein after thrombectomy may be preferable Postoperatively, the patient's legs are wrapped in elastic bandages and elevated acutely with the foot of the bed also raised, and active muscle action is started The authors have not used anticoagulants postoperatively

Massive Thrombophlebitis, according to B N Catchpole[7] (Univ of Sheffield) may rapidly kill by immobilizing large amounts of fluid and blood in the leg Alternatively it may cause "stagnation" gangrene of the foot, which may be confused with an arterial ischemic lesion Massive thrombo-

(6) Surgery 40 387 390 August, 1956
(7) Lancet 1 343 348 Feb 16 1957

phlebitis is not uncommon, but it is probably often misdiagnosed and wrongly treated.

Symptoms of the condition result from venous occlusion sufficient to cause nearly complete arrest of capillary blood flow, occurring as a solitary dramatic episode or a series of attacks over days or hours. The veins involved may be predominantly those carrying blood out of the limb at its root,



Fig 61.—Massive thrombophlebitis of leg and foot. (Courtesy of Catchpole, B. N.: Lancet 1 343-348, Feb. 16, 1957.)

the small radicles at the periphery or both groups of vessels Another consequence of the high capillary pressure is a considerable rise of capillary filtration, which leads to rapidly developing edema. Loss of circulating blood volume, both in congested vessels and by edema fluid, may be sufficient to produce fatal oligemic shock. If ischemia lasts long enough, gangrene results; usually this is moist, but occasionally it is dry, variable in extent and commonly involves the distal part of the foot.

The etiology of massive thrombophlebitis seems to be similar to that of the less extensive form (white leg, phlegmasia alba dolens). The condition is often associated with inflammation or neoplastic disease of the pelvis. Men and women

are equally involved and no age group seems immune. The symptoms resolve as unoccluded venous channels dilate; intense congestion remits, and edema fluid is absorbed slowly.

Figure 61 shows the condition in a woman, 34, after birth of an anencephalic child. The patient displayed no shock or arterial insufficiency in the feet; the left leg was edematous to the groin. Anticoagulant therapy and paravertebral block were not beneficial, the swelling slowly resolved, and the necrotic areas of the toes were allowed to demarcate before surgical removal; complete healing was slow. The patient is well, but must use an elastic support to control the hydrostatic edema of the left leg.

With recurring thrombophlebitis, correct diagnosis usually is simple. Often, however, the single dramatic episode of massive thrombophlebitis may be confused with acute ischemia of arterial origin. Differentiation may be made on the basis of more extensive involvement in massive thrombophlebitis, the dark color of the skin, severity of pain and rapid development of edema with its risk of secondary circulatory collapse.

Vigorous treatment early in the fulminating type of disease is urgently needed to prevent or overcome shock and to avert speedy death. Attempts to induce vasodilation are contraindicated, and initial anticoagulant therapy should be avoided. Elevation of the limb is desirable, with continuous passive exercise to pump blood from the congested tissues, if it is not feasible to remove the offending blood clot surgically.

Indications for Surgical Treatment of Postphlebitic Syndrome were few in 154 indigent or low-income patients treated by J. Cuthbert Owens and Leighton L. Anderson[8] (Univ. of Colorado). Operations were performed on 37 extremities in 28 patients. Most were excision and stripping of varicose veins done 3-6 months after beginning treatment and after swelling had completely disappeared or lessened to afternoon swelling. Three patients had ulcers excised and skin grafts applied; none of the ulcers recurred. One malignant ulcer was widely excised and grafted; no recurrence was noted during an 18-month follow-up. One modified Kon-

(8) Surgery 41:81-93, January, 1957.

doleon was done for a large maggot-filled ulcer on a brawny, edematous leg

Conservative treatment brought satisfactory results in 85% of the patients, with excellent results in 45% Results were fair in 8% and poor in 7% Allied disorders and failure to co-operate were the principal reasons for treatment failure The program requires careful patient education and co operation, vigorous treatment of allied disorders, control of local infection, and elevation, compression and exercise followed by progressive edema free ambulation with compression

The authors believe that surgery has its place in treating the postphlebitic syndrome but should be reserved for complications which have failed to clear after a thoroughly conservative regimen

Postphlebitic Syndrome Major Vein Ligation and/or Lumbar Sympathectomy Louis T Palumbo, Philip J Moning and Raymond Vespa[9] (Des Moines, Ia) consider that major vein ligation and lumbar sympathectomy or sympathectomy alone is helpful for patients with recurrent pulmonary infarction and/or recurrent propagating thrombosis associated with increasing disablement The operations prevent further pulmonary infarctions and blockage of renal veins eliminate recurrent thrombophlebitis relieve vasospasm allow development of vascular collateral channels and improve peripheral circulation to the extremities They eliminate sweating, this increases warmth of the extremity and prevents skin maceration and cracking between digits and thus reduces or eliminates cellulitis, lymphangitis, fungous infections and severity of pain because of division of the vasosensory supply to the vascular tree of the extremity

Major vein ligation plus lumbar sympathectomy was performed in 18 patients and lumbar sympathectomy alone in 20 Patients had had postphlebitic syndrome for many years and had not responded to medical or surgical treatment Pulmonary infarction had occurred in 14 Pain, edema and recurrent phlebitis were the most common complaints Cellulitis ulceration and stasis dermatitis were present in one-third Site of major vein ligation was the inferior vena cava

(9) Am. J Surg 91 890 893 June 1956

in 9, common iliac in 6, external iliac in 1 and superficial femoral in 3

There were no operative or postoperative deaths Patients were followed for an average of 3 years Sympathectomy in both groups resulted in a warm and dry extremity, improving circulation and eliminating infection. Ligation of a major vein did not cause further disablement in most cases Recurrent phlebitis did not occur in those who had a vena cava or common iliac vein ligation In 30-50% of cases, the patient could return to work Elastic stockings were needed in almost all cases in which ligation of a major vein was above the superficial femoral Edema improved with time in most persons in both groups In over 40%, walking distance improved Burning, aching and tenderness of the limbs improved Recurrent ulceration arose more frequently in those who had only sympathectomy Varices occurred in 25-50% of patients with major vein ligations, compared to 13% in the sympathectomy group Recurrent phlebitis was not present in those who had high major vein ligation, whereas phlebitis developed in 50% of patients with superficial femoral vein ligation and those who had lumbar sympathectomy Circumference of the limbs was decreased in 25% of patients with vena cava ligations, in 50% with superficial femoral vein ligation and in 40% with only lumbar sympathectomy Over-all results with vena cava ligation and lumbar sympathectomy were better than those with other types of major vein ligation

Deep Vein Ligation in Postphlebitic Extremity. The most important single factor in development of postphlebitic changes is the distortion of valves in the deep and communicating venous systems Ligation of the deep veins produces, in a sense, an effective valve, but venous outflow from major channels is obstructed It is essential to successful ligation therefore, that adequate collateral channels around the level of ligation be present Bauer showed such pathways by phlebography

Ralph A Straffon and Robert W Buxton[1] (Univ of Michigan) followed 45 patients in whom unilateral or bilateral postphlebitic sequelae were treated by deep vein ligation

(1) Surgery 41 471 477 March 1957

The mean follow-up time was 8 years Deep vein ligation in the postphlebitic extremity did not produce significant improvement in symptoms of all patients so treated Meticulous attention to cleanliness of the feet, elevation of the legs when sitting, carefully fitted elastic support applied before arising, prompt interruption of any dilated superficial veins and excision and grafting of ulcers which fail to respond to conservative measures may give results more favorable than those obtained with the addition of deep vein ligation to this program

► [This thoughtful and critical appraisal of the procedure of deep vein ligation in the postphlebitic extremity by Straffon and Buxton deserves serious attention Particularly significant is the fact that in their original report in 1944 they were inclined to believe that the procedure was beneficial on the basis of early results but 6 years later, after longer follow up observations they reported that the procedure gave no better results than a vigorous well planned conservative program This latter conclusion now receives further confirmation on the basis of even greater experience and longer follow up observations It may be hoped that others with less experience and thoughtful consideration of this problem will be persuaded *to abandon this irrational procedure —Ed*]

Popliteal Vein Ligation in Treatment of Lower Limb Stasis Syndrome Three- to Six-Year Evaluation Thomas O Murphy, John J Haglin Edward C Emerson and Davitt A Felder[2] (Univ of Minnesota) reviewed results of 72 popliteal vein ligations, performed in 63 patients, 3-6 years after surgery Indications for ligation were lower limb stasis syndrome, not adequately controlled by conservative management and popliteal vein incompetence demonstrated by retrograde phlebographic study Bauer's technic was used ligation and division of the vein was well above the joint space Improvement was achieved in 42% of patients A more accurate method of evaluating popliteal vein incompetence may be needed for choice of patients with the lower limb stasis syndrome who are to undergo this procedure

Results and Technic of Stripping Operation for Varicose Veins are discussed by Thomas T Myers[3] (Mayo Clinic) Stripping means removal of the incompetent part of the venous system A length of vein that is not too tortuous can be removed by passing a stripper through it either from a proximal to a distal incision or vice versa It is also possible to

(2) A M A Arch Surg 74 105 111 January 1957
(3) J A M A 163 87 97 Jan 12 1957

pass the stripper in both directions, e g , from the knee Veins too tortuous to permit passage of the stripper must be removed by dissection or evulsion If the great saphenous vein is involved, it must be ligated flush with the femoral vein at their junction, and the dissection at the groin is exacting All other veins coming into the femoral laterally and medially should be ligated and removed by direct dissection, and the medial and lateral superficial branches of the great saphenous system should be prepared for removal if they are large The flash bleeding that follows stripping usually stops soon, and the broken smaller tributaries retract If bleeding persists, packing the channel and ligation or removal of the responsible tributaries may be necessary Follow-up of 2,660 stripping operations showed 94% good or excellent results

Operations that are not extensive enough are responsible for most persistences or so called recurrences A review of 510 surgical procedures for so-called recurrent varicosities revealed that in 291 (60%) of the extremities the veins had not been adequately tied at the groin, in 231, the ligation was too low and left the tributaries at the saphenofemoral juncture Ligation of the groin was adequate in the 2 extremities in which stripping had been done, but stripping had been inadequate, and the perforating veins had not been handled properly These figures indicate the importance of dissection at the groin in all operations for varicosities

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ABDOMEN—GENERAL

Emergency Management of Abdominal Trauma, necessarily definitive in character, is discussed by Pat R Imes[4] (Univ of Louisville) On the patient's arrival at the hospital resuscitation measures are begun Although the emergency nature of treatment should be kept in mind, a few hours usually can be well spent in preoperative care and study of the patient He should be placed in a warm room and made comfortable with judicious use of analgesics Body

(4) S Clin North America 36 1289 1294 October 1956

heat is retained bv use of blankets Keeping the patient on a wheeled stretcher facilitates care examination and move ment with least disturbance to him Restoration of diminished circulating blood volume, begun with blood plasma or plasma expander at the accident scene when indicated, is continued in the hospital until properly matched whole blood is avail able Usually, 1 or 2 units of blood over 1 hour may suffice in the less severely injured with slight to moderate shock, with systolic blood pressure of not less than 100 mm Hg For the more severely injured in profound shock, with systolic blood pressure of 0 70, 6 8 times that amount may be given over 2-4 hours For patients with persistent intra abdominal hem orrhage, with or without diffuse fecal contamination of the peritoneum, resuscitation is practically impossible There fore, immediate operation is indicated to stop hemorrhage or peritoneal contamination

On examination, abdominal tenderness and rigidity indi cate visceral involvement On auscultation, peristaltic sounds indicate an intact peritoneum, but their absence is not a reliable sign of visceral injury Trauma to the lower thoracic cage, spine and bony pelvis, as well as to the ab dominal parietes, often produces an ileus with no peristaltic sounds An x ray of the abdomen may reveal not only a retained missile, but also occasionally free gas, indicating perforation of the gastrointestinal tract Diagnosis of vis ceral injury not infrequently is uncertain even after the most painstaking examination and observation

When resuscitation either reaches the optimal stage or is of no avail, surgery should be carried out without delay Ether, given in a closed system through an endotracheal tube, is the anesthetic of choice Surgery should adhere to the following principles control of hemorrhage, thorough, systematic examination of all viscera involved, accurate care of all wounds of hollow viscera, excision of nonviable tissue and removal of foreign material, and drainage of the con taminated retroperitoneal space

Wounds of the stomach usually are amenable to simple closure Duodenal wounds often require extensive mobiliza tion of the viscus for accurate identification and repair with out undue tension on the suture line Wounds of the small in-

testine usually are multiple and most often are suitable for simple closure Wounds of the colon that are closed without tension and with an intact blood supply are in no greater danger of breaking down than those of other segments of the gastrointestinal tract Wounds of the extraperitoneal rectum are best managed with a proximal fecal diverting colostomy, suture of the rectal wound when feasible and drainage of the presacral space through a postanal incision Wounds of the liver may be the source of considerable hemorrhage Fortunately, by the time of operation, bleeding either has ceased or may be controlled by light pressure from a pack of absorbable material Injuries to the spleen require splenectomy, even though bleeding has ceased or appears to be subcapsular, otherwise, delayed bleeding—days or weeks later—is possible

In abdominal injuries, the most lethal factor is the degree and duration of shock Furthermore, the number of viscera involved is in direct relation to the mortality rate About two thirds of all fatalities from abdominal trauma may be attributed directly to shock Perhaps no more than 10% of the deaths are due to peritoneal infection Another 10-15% result from pulmonary complications The other fatalities (about 10%) result from associated injuries, intestinal obstruction, delayed hemorrhage and overlooked and untreated injuries

Causes of Delayed and Obscure Intra-abdominal Hemorrhage Following Trauma were studied by William A Altmeier, Roger Sherman and C Thomas Fultz[5] (Univ of Cincinnati) in 30 patients, aged 9 63 Delayed rupture of the spleen was the most frequent cause, occurring in 66% Other causes included delayed rupture of the liver, laceration of the pancreas, needle biopsies of the liver and kidney, intramural hematoma of the duodenum and postoperative hemorrhage resulting from either a slipped ligature or heparin sodium therapy The incidence of immediate hemorrhage from a ruptured spleen was 6 times greater than that of delayed hemorrhage

Delayed bleeding from the liver after nonpenetrating trauma is less frequent than that from the spleen In this

(5) J.A M A. 163 705 708, Mar 2 1957

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study, 11 patients had acute rupture of the liver with intraperitoneal hemorrhage resulting from nonpenetrating injuries The bleeding was immediate in 10 and delayed in only 1 Prompt recovery from a nonpenetrating abdominal injury does not rule out serious visceral injury Lacerations may be present, but obscured by associated injuries, a slow rate of bleeding or only temporary or intermittent control of the bleeding point

Besides the 30 patients studied, an indeterminate number had lesser degrees of hemorrhage, in most of whom it went completely unrecognized In some, the hematoma developing within the liver or spleen became transformed into a pseudocyst or calcified cyst, which was found at autopsy after death from unrelated causes

Obscure or delayed hemorrhage should be thought of if the patient has a history of trauma Other principal diagnostic aids include the usual signs of blood loss, the presence of abdominal pain, usually localized in the upper abdominal quadrant, the reference of pain to the shoulders, the detection of shifting dulness, or one or more fractured ribs It is important to consider all patients with lower rib fractures as candidates for obscure splenic or hepatic bleeding Abdominal x rays and abdominal paracentesis may aid in diagnosis Delayed hemorrhage with shock requires immediate surgery

Abdominal Pain in Essential Hyperlipemia Hyperlipemia is observed in lipid nephrosis, the nephrotic state of glomerulonephritis, thrombosis of the renal veins, diabetes mellitus pancreatitis, hepatic disease, pregnancy, myxedema, poisoning, cachectic states, glycogenosis (Gierke's disease) and phosphatide histiocytosis (Niemann-Pick disease) Albinus Garunas[6] (Berwyn, Ill) believes the term should be reserved exclusively for abnormal increases in neutral fat, and "hyperlecithinemia" and "hypercholesteremia" should designate elevations of the lipids they denote Hyperlipemia may be caused by sluggish removal of neutral fat from the blood into fat depots and metabolic pathways Clinically, essential hyperlipemia may be manifest as abdominal pain, hepatosplenomegaly or xanthomatous skin lesions, with elevated fast-

(6) J A M A 163 1135 1137 Mar 30 1957

ing levels of serum neutral fat The abdominal pain can be easily confused with conditions requiring surgery The author reports a case in which several exploratory operations were performed before correct diagnosis was made

Woman, 27, had epigastric pain for 4 years at intervals of 3-4 weeks The pain was characterized by rather diffuse, constant aching with occasional sharpness or soreness across the upper abdomen, usually with nausea and vomiting, but without fever The pain subsided after 3-4 days and was relieved by "pain pills" or a hot-water bottle Abdominal surgery 3 years before admission was reported as revealing chronic cholecystitis, cholelithiasis and a normal appendix Pain persisted, and exploration 6 months later was negative Laboratory work at that time showed serum cholesterol 236 mg /100 ml esters 106 mg /100 ml, phospholipids 320 mg /100 ml, and serum fatty acids 1,860 mg /100 ml

The next year, the patient was hospitalized twice for "acute and chronic pancreatitis" During this period, the serum was "very lipemic" Total serum lipid levels were 3,200 mg /100 ml (normal 340-800 mg /100 ml) Physical examination was negative except for the abdominal scars Family history revealed that the mother died at age 56 of a heart attack the father was alive at age 64 There were 4 healthy siblings The father's serum lipid level was 740 mg /100 ml

During 22 months of observation the patient had only 4 severe attacks of abdominal pain with vomiting and tenderness over the abdomen although she was on a regular diet with no fat restrictions She was instructed to follow a low fat diet

Abdominal pain is characteristic of essential hyperlipemia Whether chronic pancreatitis causes hyperlipemia or whether pancreatitis follows hyperlipemia is unknown The diseases may be identical A low fat diet may reduce total serum lipids and eliminate abdominal pain Prognosis is good

Subphrenic Abscess denotes infection occurring in the region bounded by the diaphragm above and by the transverse mesocolon, transverse colon and great omentum below The liver divides this region into upper and lower compartments The suprahepatic compartment is divided into left and right portions by the falciform ligament, and the infrahepatic compartment is similarly divided by the ligamentum teres and ligamentum venosum The suprahepatic space between the right lobe of the liver and the diaphragm, bounded posteriorly by the coronary and right triangular ligaments, is large On the left side a large space separates the left lobe of the liver, spleen and stomach from the diaphragm

Geoffrey H Wooler[7] (Leeds, England) reviewed the histories of 50 patients with subphrenic abscess (on the right in 37, on the left in 11 and bilateral in 2) Of these on the right side, 10 followed a perforated peptic ulcer, 5 appendectomy, 5 cholecystectomy and 3 partial gastrectomy Four were of insidious onset, and no obvious cause was found Four were associated with infected hydatid cysts of the liver, 2 with perinephric abscess 1 with a staphylococcic liver abscess and another with an infected amebic liver abscess One was caused by a duodenal diverticulum perforating retroperitoneally, and 1 followed hysterectomy and a pelvic abscess Of the left-sided abscesses 4 followed gastric resections, 2 perforated peptic ulcers and 2 appendectomy, 2 were associated with perinephric abscess and 1 with infected hydatid cysts of the liver and spleen One of the patients with bilateral subphrenic abscesses had recently had an appendectomy the other had an enormous infected amebic abscess of the liver Only 1of the 50 patients died

Thirty-three patients had a preceding abdominal operation or catastrophe of some kind Sometimes onset may be insidious, without a previous history of abdominal complaint Occasionally, the patient may have complications of the disease such as pleurisy with effusion empyema and lung abscess and bronchial fistula

The main x ray findings were loss of diaphragmatic movement and elevation of the diaphragm, which may affect only one portion rather than the whole diaphragm, gas or a fluid level under the diaphragm, enlarged liver shadow thickening of the left dome of diaphragm, and pleural effusion

Some inflammatory processes in the subphrenic spaces will resolve with antibiotics If the abscess is caused by a chemical reaction rather than bacterial infection, e g, from perforation of a peptic ulcer the fluid formed is not pus and the abscess clears with conservative treatment If the diaphragm becomes elevated or does not move properly or if fluid appears in the pleural space, conservative treatment should probably be abandoned At this stage it would be justifiable to explore the subphrenic region with a needle However, this should be done in the operating room, so that if pus is obtained the abscess may be drained without delay

(7) Thorax 11 211 222 September 1956

Anterior abscesses between the liver and diaphragm, or between the liver and stomach on the left side, may be drained through a type of Kocher incision Morison's pouch and the right infrahepatic space may be drained through the right loin The lesser sac can be drained through the left loin The main suprahepatic spaces require a transthoracic approach through resection of 10th, sometimes the 9th, rib If mobilization of the pleura is not possible, the parietal pleura may be pushed against the diaphragm with the left hand and the two stitched together, or the pleura may be opened and the diaphragm immediately grasped with tissue forceps and pulled through the hole in the pleura to obstruct it and the two stitched together

The diaphragm is opened, pus evacuated and the shape and extent of the abscess cavity seen and palpated The wound is closed round a large soft rubber tube connected to an underwater drainage bottle A postoperative x ray is taken and if either air or fluid is present in the pleural cavity, it is aspirated and removed completely

An empyema should be drained by a separate tube connected to another underwater seal bottle The track of this tube must be separated from the one draining the subphrenic abscess This is achieved by suturing diaphragm to chest wall between the two tubes and also closing the wound and skin together between them The subphrenic cavity will close first, its walls are soft and mobile and usually heal in a few days

► [The author's advocacy of the transpleural method of drainage originally proposed by Trendelenburg in 1883 and his failure even to *mention* the extraserous methods of drainage reflect an inadequate appreciation of the problem The obvious disadvantage of the former method lies in the risk of contamination of the pleural cavity, which experience has shown to be considerable despite the various technical modifications of the procedure to avoid it This danger is readily avoided by the extraserous method originally proposed by Nather and Ochsner in 1923 in which the abscess is [illegible]) The superiority of this has been well demon

Experiences with Ileal Conduit in Urinary Diversion in 13 patients reported by William J Baker and Edwin C Graf[8] (Chicago) were gratifying Diversion of the urinary stream to an isolated ileal segment has many advantages over other procedures Continuous contamination by the fecal stream

(8) J Urol 75 950 960 June 1956

was avoided The fecal current was preserved and no colostomy was needed Little or no absorption of metabolites or electrolytes into the circulation was found No reservoir existed to allow constant exposure of intestinal mucosa to urine Reflux of infected secretions was avoided because the hydrostatic pressure gradient could not be reversed Preservation of the ureteral blood supply enhanced healing without stricture The ureteral blood supply was maintained because only short segments of the ureteral bed were disturbed The ileal segment was fixed to the posterior peritoneum where the ureters emerged from the retroperitoneum Preoperative preparation was relatively simple A high-protein, low residue diet supplemented by vitamins was used Sulfasuxidine®, 12 Gm daily, was given for 5 days Repeated enemas were given the morning of surgery until the return flow was clear Wangensteen drainage was started the night before surgery The usual attention to the hemogram, a positive nitrogen balance and the cardiovascular status was necessary, *as in all major surgery*

The surgical technic described by Bricker was used The ileocecal segment was avoided because of vascular limitations in this area A sufficient length of ileum was used to establish a conduit from the cutaneous ostium in the lower right abdominal quadrant to the promontory of the sacrum End to end ileoileostomy and anastomosis of both ureters to the conduit completed the operation Minimum segments of ureter were isolated The mucosa-to mucosa method of ureteral anastomosis was preferred Splinting ureteral catheters were used to insure against early postoperative edema and obstruction at the anastomotic site

Postoperative management presented no unusual problems The threat of abdominal distention required the extended use of Wangensteen drainage Mucus issuing from the ileostomy soiled the dressings Indwelling plastic ureteral catheters became plugged Removal of the catheter is preferable to overzealous attempts at irrigation Blood chemistry determinations showed no abnormal deviations Use of the ileostomy bag was delayed until healing became established

THE LIVER AND SPLEEN

Benign Tumors of Liver are discussed by Stanley W Henson, Jr, Howard K Gray and Malcolm B Dockerty and George A Hallenbeck (*V Traumatic Cysts*)[9]

I Adenomas—All cases of primary benign tumors of the liver found in the surgical files of the Mayo Clinic between 1907 and 1954 were studied The tumors were classified according to the following scheme

I Parenchymal tumors
  1 Hepatic cell adenomas (hepatoadenomas)
  2 Bile duct adenomas (cholangioadenomas)
  3 Mixed hepatic cell and bile duct adeno mas (cholangiohepatoadenomas, hemartomas)
II Vascular tumors (hemangiomas, lymphangiomas)
III Cysts
  1 Congenital
    (a) Solitary unilocular cysts
    (b) Diffuse polycystic disease
  2 Traumatic
  3 Inflammatory (specific, nonspecific)
  4 Neoplastic (cystadenomas, dermoids, cystic teratomas)
  5 Parasitic
IV Others (fibromas, lipomas, leiomyomas terato mas, adrenal rests)

There were a total of 13 adenomas Hepatoadenomas, the first group, are tumors composed of hepatic cells Included are localized nodules of regenerative hyperplasia that have progressed to the formation of large tumors They are distinguishable from hamartomas, with which they sometimes are confused, and probably require no treatment, although this has not been proved Four large tumors of this type were included in the series Three patients had complete excision of the tumor, while the remaining patient had biopsy only All are alive and well 2 27 years after diagnosis

Cholangioadenomas, the second group, are tumors originating from bile ducts, usually in the form of small subcap sular collections of proliferating bile duct epithelium They

(9) Surg Gynec & Obst 103 23 30 July 327 September 607 612 November 1956 104 63 67, January, 302 306, March, 551 554, May, 1957

are commonly found at autopsy and are considered important because they can simulate closely a metastatic deposit and therefore should not be assumed to be malignant until proved so by biopsy Seven such tumors were included

Cholangiohepatoadenomas, the third group, are mixed tumors originating from both hepatic cells and bile ducts Two tumors of this type were included Such lesions show pronounced hyperplasia of the connective tissue elements These two tumors were similar to many that have been reported in the literature as hamartomas They occur more frequently in infants than in adults and may grow to large size They may be cystic or solid and usually are found in the right lobe They should be excised if it is possible to do so

Four of these 13 patients underwent *surgical exploration* because of clinical manifestations thought to be caused by the hepatic tumor The manifestations consisted of gradual enlargement of the abdomen, an abdominal mass, or presence of intermittent abdominal pain Examination disclosed a palpable mass in all 4 patients Roentgenograms showed a mass displacing the diaphragm or the adjacent viscera in 3 Preoperative diagnosis was an indeterminate abdominal mass in each instance, with hepatic tumor being suggested in two instances

II Hemangiomas—Thirty five cases of hemangioma of the liver were encountered Eleven patients were operated on because of clinical manifestations thought to be the result of the tumor, whereas the hemangioma was found incidentally at operation in the other 24

When symptoms are caused by these tumors, they usually *consist of pain produced by the size and weight of the tumor* or of manifestations of pressure on adjacent organs such as stomach, colon or kidney A palpable mass is found in almost every instance Roentgenograms show a soft tissue mass or displacement of adjacent viscera in a significant number of cases Hepatic function, as determined by values for serum bilirubin and retention of sulfobromophthalein, is not often altered significantly The presence of a benign hepatic tumor may be suggested by the clinical features, but diagnosis is rarely made preoperatively

Ideally, the treatment would be total excision with a rim

of normal hepatic tissue, but experience suggests that certain inoperable hemangiomas may be controlled effectively by repeated courses of roentgen therapy Since severe and even fatal hemorrhage may follow biopsy or even aspiration of such tumors, these procedures should not be done unless the surgeon is prepared to resect the tumor In this series treatment consisted of excision in most instances, though 2 patients were treated by irradiation alone and in a few only biopsy was performed There was 1 operative death No patient is known to have died of recurrence or progression of the disease during the follow up period

III Solitary cysts—Nonparasitic cysts of the liver may be single or multiple, unilocular or multilocular, localized or diffuse They may originate as congenital or acquired lesions, and their lining may be epithelial or fibrous The contents of individual cysts may be thin watery fluid, a thick viscid semi gel, blood, bile or pus, depending on the cause, lining membrane, etc

Simple unilocular cysts are relatively common, but they rarely reach sufficient size to cause symptoms When they do, the clinical manifestations are similar to those of other benign tumors of the liver Therefore, the decision as to their management must be made at the time of operation since the diagnosis is rarely made before surgical intervention

Of 38 patients who had simple unilocular cysts of the liver, 11 were operated on because of clinical manifestations thought to be caused by the hepatic tumor, a twelfth patient had symptoms produced by the cyst but died before surgical treatment could be instituted Hepatic cysts were found in the remaining 26 patients during operation for some other condition

The cysts are occasionally quite large and should be excised if this can be done safely, but partial excision and obliteration of the cavity by suture or packing seem to give satisfactory results

Complications of solitary cysts include perforation, spontaneous hemorrhage, infection or torsion, if the cyst happens to be on a pedicle

IV Polycystic disease of surgical significance—Twenty-nine patients with polycystic disease of the liver were stud-

ied, 23 being explored because of symptoms and 6 encountered incidentally during laparotomy Ten had associated polycystic disease of the kidney and 1 had cystic involvement of the spleen The disease generally becomes manifest in adults, has a long benign course and requires only symptomatic treatment, except in an occasional case in which the contents of large cysts may be aspirated to reduce the weight of retained fluid Associated polycystic disease of the kidney appears to carry a greater threat to the health and life of the patient than does polycystic disease of the liver

V Traumatic cysts—Traumatic hepatic cysts are rare, only 5 cases were encountered They usually follow rather severe abdominal trauma, and symptoms may be delayed for several months after injury Clinical manifestations include abdominal pain, freuently referred to the shoulder, a tumor that is usually palpable and, less frequently, jaundice The cyst is located in the right lobe of the liver in most instances and its contents may be blood, bile or pus If the cyst has perforated, free bile may be found in the peritoneal cavity Adequate surgical drainage appears to give excellent results

VI Multilocular cystadenomas—These rare tumors should be distinguished from cholangiectasia and localized zones of polycystic disease Clinical and laboratory features are similar to those of other benign liver tumors Pathologically, these lesions are solitary multilocular cysts with a proliferating type of epithelium, some have papillary projections resembling those seen in ovarian and pancreatic cystadenomas Because the cysts are neoplastic and tend to recur, they should be carefully excised They may be enucleated if they are well encapsulated, but if their true nature is suspected they should be excised with a rim of normal hepatic tissue

Five patients with benign multilocular cystadenomas were observed Two had recurrent tumors that had been excised previously Two of the cysts were enucleated, 2 were excised with a rim of normal hepatic tissue, and 1 was partially excised, the rest of the cavity being packed There were no operative deaths Of the 4 patients on whom follow-up studies were available 2 were known to be alive and had had no recurrence 20 and 34 years, respectively, after operation A 3d was alive but was having symptoms that may have been

due to recurrence of the tumor 8 years after operation The 4th was known to be alive and active, but with hepatomegaly, 17 years after the tumor was first excised elsewhere and 3 years after it was partially excised for the third time

Primary Carcinoma of Liver Clinicopathologic Study of 108 Cases is reported by Richard A MacDonald[1] (Boston City Hosp) These cases were found at 23,114 autopsies, an incidence of 0 47% In the 72 cases reviewed clinically, the following types of cirrhosis were present fatty nutritional cirrhosis 21, healed acute yellow atrophy, 20, hemochromatosis, 6, undetermined type, 4, and biliary cirrhosis, 4 In 17, there was no underlying cirrhosis The chief complaint of 41 patients was pain or abdominal discomfort of 13 weakness or weight loss and of 11, abdominal and leg swelling of recent onset and rapid development The clinical course was generally short the longest period of continuing symptoms was 2½ years

One patient with liver cell carcinoma had recurrent episodes of marked hypoglycemia Jaundice was present in 37 patients and usually became more severe during hospitalization Two thirds of the patients showed some ascites at autopsy A large liver was found in 42% of patients and was well correlated with findings at autopsy An enlarged spleen was found in only 3 patients Fever occurred in 57%, with daily elevations in the afternoon

The hospital course before death was less than 4 weeks in most patients Correct diagnosis was made clinically in less than 20% The most helpful laboratory determinations were serum icteric index, urine bile test, serum bromsulfalein retention, prothrombin time, serum albumin globulin ratio and serum alkaline phosphatase

The present conservative therapy of liver carcinoma offers a hopeless prognosis but no specific form of therapy can be advocated Radiation was not used as a form of therapy, and in patients who had laparotomy, no attempt at definitive surgery was made Postoperative survival of up to 9 years has been reported, but most patients have died *in* less than 5

► [Unfortunately carcinoma of the liver usually involves both the left and right lobes making resection impractical However, there is an occasional case in which the lesion is limited to one lobe. Under these circum

(1) A M A Arch Int. Med. 99 266-279 February 1957

stances resection is justified, since no other method of therapy is effective —Ed]

New Suture Method for Liver Resection that was used successfully in 2 cases of hepatocellular carcinoma and 1 of liver adenoma is presented by John R. Robinson and Harvey R Butcher, Jr [2] (Washington Univ).

METHOD —The needle is formed by bending a no 16 silver wire 20 in. long upon itself so that an open narrow loop is formed that acts as the needle point (Fig. 62, *A*). The looped end of the wire is passed

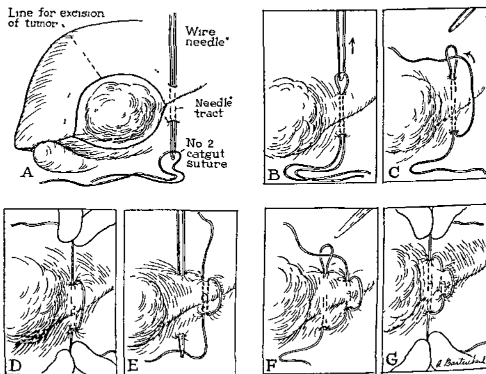


Fig 62 —Liver suture technic (Courtesy of Robinson, J R , and Butcher, H R , Jr Surgery 40 391 396, August, 1956)

through the parenchyma near one margin, 1-2 cm proximal to the proposed line of resection A full length of a no 2 chromacized catgut suture is then passed through the "eye" of the loop of wire and the wire is withdrawn, so that a loop of catgut suture is brought through the liver (*B* and *C*) One end of the suture is passed through this loop, the wire "needle" is removed from it, and the ends of the suture are drawn taut, allowing the interlocking junction of the suture to be pulled half the length of the needle tract (*C*). Tension is maintained on the previously placed suture while these steps are repeated every 2-3 cm until the portion of the liver to be resected has been com-

(2) Surgery 40 391 396, August, 1956

pletely encompassed (*D-G*). Transection of the liver parenchyma outlined by the hemostatic suture is performed about 1 cm. adjacent to it. Hemostasis is completed by ligating the few small arteries which may continue to bleed from the cut surface.

The method is good because (1) the long, blunt-pointed, flexible, bent wire passes easily through thick portions of liver parenchyma and does not puncture hepatic vessels or large bile ducts (Fig. 63); (2) there is less danger of tearing the liver on tightening the suture, because the shearing force is more equally distributed about the circumference of the encompassed parenchyma than when interrupted mat-

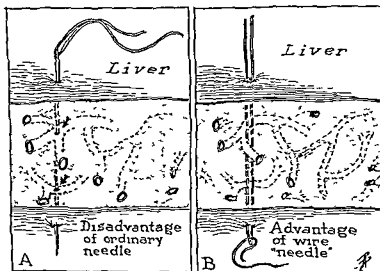


Fig 63.—(Courtesy of Robinson, J R, and Butcher, H R., Jr Surgery 40 391-396, August, 1956)

tress sutures are drawn taut, (3) the stitch is simple, rapidly placed and does not allow any portion of the liver adjacent to the line of resection to escape enclosure and (4) the suture encompassing a segment of liver does not slip from this segment because it is continuous with that surrounding others adjacent. The method can be used for large lacerations of the liver.

Differential Hypothermia in Experimental Hepatic Surgery: Application of This Technic to Problem in Clinical Surgery. Attempting to devise a more widely applicable technic for partial hepatectomy, Charles Huggins, Edwin L. Carter and William V. McDermott[3] tried differential intra-

(3) A.M.A. Arch Surg 74 327 332, March, 1957.

peritoneal cooling with cold sterile saline and postoperative antibiotic and intravenous fluid therapy in dogs This procedure was effective in preventing the gastrointestinal hemorrhage, liver damage and death seen in normothermic control animals when the aorta was occluded above the celiac axis for 1 hour

Extensive liver resections were performed after intraperitoneal cooling during occlusion of the afferent hepatic vasculature obtained by occlusion of the aorta above the celiac axis and the portal vein in the porta hepatis Similar resections were done with hepatic afferent occlusion in the porta hepatis A peripherally placed shunt was used to decompress the portal bed in these animals A technic using differential hypothermia and occlusion of the hepatic artery and portal vein in the porta hepatis with a middle colic to antecubital venous shunt was successfully tried in 1 human subject

Differential intraperitoneal cooling offers many advantages over general hypothermia in prolonging safe hepatic circulatory interruption Lesions discovered at laparotomy may be resected without wound closure and reoperation under general hypothermia later Even when hepatic lesions are suspected, their extent and resectability often cannot be accurately determined preoperatively The technic using differential hypothermia permits evaluation of resectability of hepatic lesions without committing the patient to general hypothermia or a staged operation

Rationale of Surgery under Hypothermia in Certain Patients with Severe Hepatocellular Disease was studied by William F Bernhard, George F Cahill, Jr, and George W Curtis[4] (Boston) A lethal period of hepatic hypoxia (60 minutes) was produced in two groups of dogs by temporary occlusion of the hepatic artery, portal vein, celiac axis superior and inferior mesenteric arteries In group I, the period of ischemia was induced in normothermic animals and in group II, a similar occlusion period was produced in hypothermic (77 87 8F) animals The standard period of hepatic anoxia produced profound hypotension in normothermic dogs and marked pulmonary hepatic and gastrointestinal congestion Mortality in this group was 100% Glycogen deple

(4) Ann Surg 145 289 303 March 1957

tion was noted quantitatively and histologically in these animals with elevation in intracellular glucose and lactate. The hypothermic dogs of group II survived the period of occlusion without evidence of hepatic damage. Hepatic glycogen, glucose and lactate concentrations were unchanged in the limits of the experimental methods.

The clinical application of hypothermia in management of certain surgical patients with severe hepatocellular disease might be helpful in marked cirrhosis, portal hypertension and esophageal varices, necessitating a decompressive shunt operation; to facilitate surgical control of actively bleeding varices without enhancing hepatic damage secondary to hypotension, anoxia or prolonged anesthesia; and to make feasible resection of primary or metastatic hepatic tumors in a dry operating field during temporary hepatic vascular occlusion.

► [The observations derived from the 2 preceding reports of well-designed experiments may be of considerable clinical value. Some differences, however, seem to exist between man and dogs in the ability of the liver to tolerate temporary periods of ischemia. In dogs, for example, occlusion of the aorta above the celiac axis for 1 hour usually produces death, yet in man experience with aneurysmectomy has demonstrated that this period of aortic occlusion is well tolerated. Similarly, experience with resection of aneurysms involving the aorta at the level of the celiac axis has shown that [illegible] 116 minutes is satisfactorily tolerated, [illegible] the maximum safe period of [illegible] Nonetheless, the observations [illegible] which this margin of safety

Ligation of Hepatic Duct in Treatment of Cirrhosis of **Liver (Schalm's Operation).** H. R. Bax[5] (Arnhem, The Netherlands) observed in animal experiments that obstruction of the bilary tract to atrophy of the corresponding part of the liver and to hypertrophy of that part which had an unobstructed efferent duct. Similar observations were made in human subjects in whom total obstruction of one of the larger bile passages or a large portal branch had occurred years before examination incidentally revealed an atrophic hepatic lobe and a lobe showing favorable hypertrophy. In these patients, there was nothing in the histories to suggest functional disturbance. These observations suggested ligation of the hepatic duct as a suitable surgical measure.

(5) Arch. chir. neerl. 8:331-343, 1956.

Among 6 patients with cirrhosis treated by ligation of the hepatic duct, results were promising in 2 The other 4 patients demonstrated the hazards of the operation, the possibility of an erroneous or incomplete diagnosis and of an incorrect technical performance, notably "misplaced" ligation and fatal hemorrhage

► [The author of this article concludes that 'the useful effect of ligation of the hepatic duct in the treatment of cirrhosis of the liver has not yet been demonstrated with sufficient certainty' With this much of the article I am in complete agreement Neither the rationale of this procedure nor the mortality rate can be considered acceptable —Ed]

Bleeding Esophageal Varices Study of Cause of Associated "Hepatic Coma" In clinical and experimental studies William V McDermott, Jr, Joan Wareham and Athol G Riddell[6] (Boston) found that in the presence of spontaneous or surgically constructed portal systemic shunts, introduction of blood into the gastrointestinal tract is accompanied by striking elevations in the level of peripheral blood ammonia If the elevations are sufficiently high central nervous system symptoms appear, ranging from mild confusion and disorientation to deep coma Frequently, symptoms are reversible, but the clinical syndrome may terminate fatally

In the animal experiments a significant finding was that hyperammoniemia did not parallel the "alimentary azotemia" Normal animals showed the expected rise in blood urea nitrogen, but blood ammonia levels remained normal In Eck fistula dogs, however, there was much less significant rise in blood urea nitrogen, but consistent and striking hyperammoniemia

Though the clinical studies were not as clearcut as the animal experiments, all patients studied showed striking elevations in peripheral blood ammonia, the degree of elevation correlated reasonably well with the severity of the central nervous system symptoms

Studies both in the dog and in man have shown that the portal vein consistently contains a large amount of ammonia nitrogen which fluctuates with the amount of nitrogenous material taken into the gastrointestinal tract It appears that the ammonia nitrogen is derived from action of amino acid oxidase and urease on ingested protein and other nitrogenous

(6) Ann Surg 144 318 334 September 1956

substances, these enzymes apparently are derived from intestinal micro-organisms Normally, this ammonia is synthesized to urea in the liver, which thus forms a protective barrier against accumulation of toxic levels of ammonia in the systemic circulation In spontaneous or surgically constructed portal systemic shunts, however, channels exist whereby the ammonia derived from enzymatic breakdown of nitrogenous material can bypass the liver and cause abnormal elevations of ammonia nitrogen in the peripheral blood The lesser degree in elevation of blood urea nitrogen in the Eck fistula dog than in the normal animal suggests that shunting of portal blood around the liver interferes with the normal rate of urea synthesis

The authors do not feel that ammonia intoxication is the only or predominant feature in all cases of "hepatic coma" Coma associated with terminal hepatic decompensation is a more complicated metabolic problem

On the basis of these observations, the following program for management of bleeding esophageal varices is suggested Hemorrhage should be controlled to prevent accumulation of a nitrogenous pool in the gastrointestinal tract, initially by balloon tamponade and when stabilization is achieved, by transfusions and direct transthoracic ligation of the varices Catharsis and enemas will eliminate the blood, the source of absorbed ammonia By depressing the bacterial count in the gastrointestinal tract with antibiotics, the sources of urease and aminoacid oxidase can be controlled Furthermore, l glutamic acid has proved a valuable adjunct to therapy

► [This is an excellent study, providing significant and useful information in the management of this grave problem —Ed]

Splenoportography in Portal Hypertension: Its Value in Selecting Operative Procedure of Choice is summarized by William P Mikkelsen and Arthur C Pattison[7] (Univ of Southern California) X ray visualization of the portal venous system is an almost indispensable adjunct to surgical management of portal hypertension Splenoportography, when properly carried out, clearly delineates this system and avoids tedious, and sometimes hazardous, surgical dissec-

(7) California Med 86 235 241 April 1957

tion. Moreover, extensive surgical dissection in these patients frequently does not uncover the full extent of the disease process. In many cases of portal hypertension, splenoportography will provide the basis for selection of the operative procedure. Certain instances of intrahepatic portal hypertension due to cirrhosis that might be managed better by splenorenal shunt, rather than by the generally preferred method of direct end-to-side portacaval shunt, may be determined by this procedure. The method finds its greatest application in accurate delineation of the three major types of extrahepatic portal hypertension, each of which demands a different surgical approach.

Splenoportography has been performed in the x-ray department by percutaneous splenic injection of radiopaque material under local anesthetic skin infiltration. Since the authors encountered significant splenic hemorrhage early in their experience, they now perform splenoportography in the operating room after the abdomen has been opened This permits direct tamponade of the splenic puncture site after completion of the injection.

Ligation of Esophageal Varices by Transabdominal Route was performed by C. Stuart Welch[8] (Albany Med College) in 5 men, aged 45-68, with cirrhosis of the liver and a bleeding episode, using the following procedure

TECHNIC —With the Sengstaken-Blakemore tube in place, the abdomen is entered through an upper midline incision and the xiphoid process removed. The terminal esophagus and stomach are exposed as in vagectomy, repair of hiatus hernia, total gastrectomy and the Heller procedure. The left lobe of the liver is mobilized by incision of its suspensory ligament

The second step is incision of the peritoneal reflection at the esophagogastric junction The esophagus is easily identified The Sengstaken-Blakemore tube is kept inflated. By blunt-finger dissection, the esophagus is encircled A variable number of preliminary ligations of large veins at the [illegible] are made

The next step is severance [illegible] gogastric-diaphragmatic ligaments Thes[illegible] bands of *tissue coming off at the junction of the esophagus and stomach,* from where they pass posteriorly and laterally onto the diaphragm The esophagus is freed in the mediastinum by blunt dissection and then pulled down into the abdomen The inflated gastric balloon greatly facilitates this step since it can be grasped for downward traction

(8) New England J Med 255 677 683, Oct 11, 1956

Further blunt dissection posterior to the esophagogastric junction is carried out until 8-9 cm of esophagus is brought into the abdomen When mobilization is adequate, a 16 F. catheter is placed around the esophagogastric junction to be used for traction The gastric balloon is then deflated By use of a long hemostat, the catheter surrounding the upper part of the stomach is snugged up and acts as a tourniquet This maneuver decreases bleeding during esophagotomy by blocking the upward flow of portal blood Before the esophageal balloon is deflated, the esophagus and stomach are opened longitudinally for about

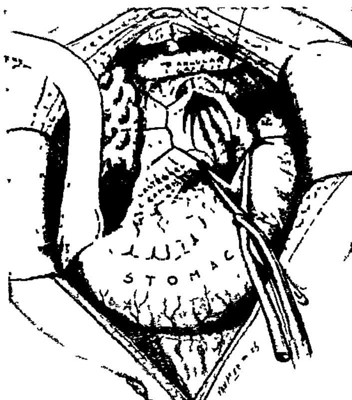


Fig 64 —Midline incision of abdomen with xiphoid process resected (Courtesy of Welch, C S New England J Med 255 677 683, Oct 11, 1956)

9 cm The edges are grasped with a long Babcock forceps and oversewn with a running stitch if bleeding is brisk The esophageal balloon then is deflated and withdrawn upward beyond the exposed interior of the esophagus It is important to open a short distance into the stomach since gastric varices are often present and the bleeding area usually is at the esophagogastric junction Varices are easily identified, although the point of bleeding may not be Usually, there is a reddened, swollen, berry-like area at the esophagogastric junction that looks suspicious Ligation is begun cephalad as high as possible A continuous locking suture of 000 chromic catgut is used, going through the mucosa, catching the veins and continuing downward

over the esophagogastric junction into the stomach Two or three groups of varices are ligated Before the esophagus and stomach are closed the rubber catheter used as a tourniquet to control bleeding *must be released and the interior inspected so no bleeding point is* missed If the field is dry an ordinary sterile Levin tube is attached to

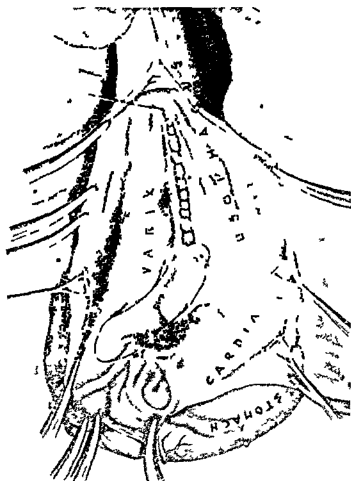


Fig 65 —Details of suture ligation of esophageal varices (Courtesy of Welch C S New England J Med 255 677 683 Oct 11 1956)

the end of the Sengstaken Blakemore tube and drawn up by the anesthetist

Closure of esophagus and stomach is made longitudinally by an inner continuous layer of 000 chromic catgut and a second layer of interrupted 000 silk sutures with an occasional third layer when needed The suture line can be reinforced by means of the esophagogastric diaphragmatic ligaments which are covered with peritoneum or the omentum can be brought up A Heineke Mikulicz closure of the esophagogastric incision which widens the junction by closing the longitudinal wound transversely is probably

not necessary since the 2 patients who survived had no serious dysphagia interfering with their alimentation. One patient experienced a short period of mild dysphagia. From a long term point of view, the Heineke-Mikulicz procedure could have disadvantages because it encourages gastric reflux and esophagitis. The abdominal wound should be closed with stay sutures. Figures 64 and 65 demonstrate the essentials of the operative technic.

Bleeding in all patients was successfully controlled, as evidenced by gastric aspiration, the clinical course in the postoperative period and by autopsy on the 3 patients who died. These 3 patients were poor risks because of the status of their liver disease and lateness of surgery.

Patients whose liver function is fairly good are favorable candidates for ligation. The earlier operation is decided on and undertaken, the better the chance of survival.

Results of Portacaval Shunts in Treatment of Portal Hypertension. Hemorrhage from esophageal varices is serious, and mortality reaches 50-70%. No method for treating patients while they are actually bleeding has been entirely satisfactory. Prevention of hemorrhage is the best approach, and portacaval shunt performed when the patient's physical condition is optimal is the best surgical procedure available. C. Stuart Welch and A. G. Ramos[9] (Albany Med. College) review results in 40 consecutive patients who had a total of 41 shunts during 7 years. Esophageal varices were proved clinically in 29 patients (73%). Portal hypertension was proved in all by clinical studies and actual measurements of pressure at surgery. Three patients had never bled, but splenorenal shunt was performed at splenectomy for severe hypersplenism.

Indications for surgery in patients with portal hypertension are history of previous hemorrhage and evidence that bleeding has occurred from esophageal varices. Occasionally, esophagoscopy and x-rays cannot demonstrate the varices. If the hemorrhage can be stopped by gastroesophageal balloon tamponade, bleeding is probably from varices, especially if liver cirrhosis is present and no other gastrointestinal lesion can be found.

Patients who survive a severe hemorrhage should be protected against another if the risk of elective surgery is not too

(9) Surgery 41:756-768, May 1957.

great Serum albumin should be 3 Gm /100 ml or more and bromsulfalein dye retention below 30% Marked jaundice is a serious contraindication since it implies severe intrahepatic disease Persistent elevation of serum bilirubin above 3 mg /100 ml, prothrombin time prolonged more than 5 seconds and persistent ascites are other contraindications to shunt surgery

Bed rest is imperative preoperatively Ascites should be relieved A general diet or one high in carbohydrate is most palatable Sodium should be restricted if ascites is marked but if such a diet is unpalatable to the patient, it should be made more liberal Blood transfusions are usually necessary but must be given with caution and not quite to normal levels If serum albumin is low and hemoglobin adequate, plasma may induce an optimum physiologic state faster than feeding alone Prolonged use of serum albumin or plasma for treatment of ascites is worthless, since ascites will disappear only if liver function improves Vitamin K is usually necessary, and vitamins B and C have been used empirically Intravenous 10% dextrose, 1,000 cc daily, may help A preoperative intravenous pyelogram determines kidney function Adequate function of the right kidney is important if use of the left renal vein for the shunt is contemplated

A splenorenal shunt should probably be planned for all patients with extrahepatic portal obstruction, since the portal vein is often obliterated or otherwise useless For intrahepatic block, there is a choice of splenorenal or portacaval shunt Direct portacaval shunt is mechanically superior to splenorenal anastomosis It is larger, less likely to become angulated, more easily performed and better prevents bleeding

The mortality rate for operation was 15% among all 40 patients, but only 10% among the 20 operated on most recently Bleeding recurred in 20%, mostly in patients who had splenorenal shunts Only 1 patient with a portacaval shunt had postoperative hemorrhage The survival rate for all patients was 58% Of 11 patients who died 1 or more years after surgery, 6 died of hepatic failure Four had had portacaval and 2 splenorenal shunts Three deaths were directly or indirectly due to hemorrhage Of 6 patients examined post

mortem, all had a thrombosed splenorenal shunt, though hemorrhage was not the cause of death in each If greater benefit is to be obtained from portacaval shunt, perhaps it should be performed in selected patients before they have bled

Portacaval Anastomosis is discussed by R Milnes Walker[1] (Univ of Bristol) To prevent hemorrhage from esophageal varices in patients in whom the operation is feasible, an end to side portacaval anastomosis is most effective By careful selection of patients, the operative risk is small, among the author's 56 patients, there were 3 deaths The results are most satisfactory unless some disease causes progressive deterioration of liver function The most serious drawback of the operation is the neuropathy which may result from a large portal systemic shunt Symptoms, usually transient develop in about 20%, but are rare in those whose liver function is normal

In a follow up extending to 69 months 2 patients who had previously had splenectomy had recurrence of hemorrhage but after operation on their varices they returned to their occupations There was no recurrence of hemorrhage from varices in the 50 survivors who had not had a previous operation involving the portal venous system, but 4 later died 1 of hemochromatosis 2 of cirrhosis and 1 of unrelated disease Of the other 46 35 have no symptoms and are leading normal lives and 7 have been operated on too recently to be back at their occupations

Emergency Portacaval Shunt Major hemorrhage from esophageal varices is a prime medical emergency Loss of blood endangers the life of the cirrhotic patient directly by exsanguination and indirectly by precipitating hepatic failure Nachlas and associates found hemorrhage as the precipitating or causative factor in 84 of 88 deaths in cirrhotic patients The initial hemorrhage itself was associated with a 60% mortality

Ward D O Sullivan and Mary Ann Payne[2] (Cornell Univ) subjected 9 patients to emergency portacaval shunts In each instance, temporary hemostasis had been achieved

(1) Lancet 1 57-59 Jan 12 1957
(2) Surg Gynec & Obst 103 668-676 June 1956

by use of the Sengstaken Blakemore balloon Ascites was present in 7 patients, jaundice in 6 Before surgery, 6 patients were in coma Surgical mortality was 33%, 1 patient died of hepatic renal failure, 1 of hepatic failure and hepatic vein obstruction and 1 of unrelenting hemorrhage with a thrombosed portacaval anastomosis Of 6 who survived operation, 3 subsequently died Homologous serum jaundice probably played a major role in 2 deaths The third patient died of hepatic failure, 41 months after the portacaval shunt There were no esophageal hemorrhages in those who survived With no surgical treatment or a limited surgical procedure, a higher survival rate seems unlikely The authors believe that portacaval shunt should be considered as an emergency measure for control of esophageal hemorrhage

► [Portacaval shunt appears to be the most efficacious method of preventing recurrent bleeding from the esophageal varices which are secondary to cirrhosis of the liver However its use as an emergency measure to control bleeding must be questioned —Ed]

Injuries of Spleen Report of 102 Patients and Review of Literature is presented by John H Terry, Milton M Self and John M Howard[3] (Baylor Univ) Among general admissions to hospitals the incidence of splenic rupture is relatively low, a little over 0 1%, but it is 30-48% in patients with abdominal injuries This reflects the frequency of blunt trauma especially in automobile accidents

Most patients with splenic rupture have a history of blunt or penetrating injury to the chest or abdomen In civilian populations blunt trauma predominates Of 102 patients with ruptured spleens treated during 1946 55 49 had penetrating and 53 blunt injuries Associated injuries to other organs were present in 72% Thoracic injuries, fractures and intracranial injuries were often associated The most common penetrating injury was that of the gastrointestinal tract Of patients who reached the hospital alive, the mortality was 24% both in those with blunt and those with penetrating injuries *About one third of patients died preoperatively*, chiefly of intracranial injuries secondary to blunt trauma Of the total deaths (25 patients), 48% were due directly to hemorrhage, 28% to intracranial injury and 12% to post traumatic renal insufficiency Mortality rates were directly propor-

(3) Surgery 40 615 639 September 1956

tional to the number of organs injured If the spleen alone were injured, the mortality rate was only 10%

In those with penetrating injuries, bullet wounds were the commonest and resulted in the highest mortality rate, 44% Of 21 patients with stab wounds, none died In 53 patients with blunt injuries, automobile accidents were the cause in 34 and mortality was 26% Of 91 patients with immediate rupture, 25 died Of 11 with delayed rupture, none died

After splenectomy for immediate rupture, the mortality from penetrating injuries was higher than that from blunt trauma, because of the higher incidence of associated injuries in patients with the former The anatomic type of splenic injury was not well correlated with mortality Multiple and stellate fractures and fragmentation of the spleen resulted in higher mortality rates Hilar injuries bore only a 12% mortality rate

Three fourths of patients who had delayed hemorrhage bled within 2 weeks of the initial injury Patients with suspected splenic contusion should be warned of this possibility Improvements in therapy during this 10-year period have resulted from better blood bank facilities and improved emergency care by resident surgeons Further progress depends on improvement of technics for control of intra abdominal hemorrhage

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THE BILIARY TRACT

Visualization of Gallbladder and Bile Ducts Following Trauma: Results of Study with Intravenous Cholografin® are reported by Robert S Sparkman and C Richard Jernigan[4] (Univ of Texas) with reference to studies by Howard (1954), who concluded that visualization of the gallbladder was usually unsuccessful after injuries to any part of the body Gallbladder visualization was accomplished by Howard in only 3 of 21 patients with mild to severe trauma, during the week after injury The authors attempted to duplicate the conditions of Howard's experiment but substituted intravenous

(4) Surgery 41 595-604 April 1957

Cholografin® for 4 oral cholecystographic agents he used

Single tests were performed on 26 patients at an average of 2 days after injury, 7 had penetrating wounds of the abdomen and 3 penetrating thoracoabdominal wounds Except for 2 patients with burns, all underwent some operation before cholecystography was performed Failure of gallbladder visualization was encountered in only 2 instances (Case 1—automobile collision, contusion of right upper abdomen fractured right 12th rib, laparotomy, study performed 36 hours after injury, Case 2—stab wound of abdomen, laceration of liver, hypotension, laparotomy, suture of liver, study performed 1 day after injury) In general, bile duct visualization was less satisfactory than that of the gallbladder and was good or excellent in only 6 patients, failure of visualization was noted in 5

These studies indicate that the gallbladder is capable of receiving fresh hepatic bile after trauma This disproves one explanation suggested by Howard to account for his failure to visualize the gallbladder Beyond this, present findings do not contradict or confirm Howard's results because an intravenous cholecystographic agent was used exclusively, while he used oral agents

Visualization of hepatic ducts and the choledochus occurs more slowly and less clearly after trauma than in otherwise healthy subjects Since the patients studied showed no evidence of circulatory abnormality, this finding is compatible with some degree of impairment of hepatic function secondary to injury, operation, anesthesia or a combination of these factors

Gallstones in Children Report of Four Cases seen from 1952 to 1955 the only ones on record at Milwaukee Children's Hospital is presented by Donald P Babbitt[5] Gallstones were discovered in 2 children on x rays made for other reasons All 4 patients had calcific shadows in the gallbladder region on plain films 3 had nonvisualization of the gallbladder with repeat double dose examination Calcification of the stones indicates that cystic duct obstruction probably had been present before the calculi were recognized

(5) A M A J Dis Child 92 5 8 July 1956

The youngest child had calcified gallstones at age 23 months The others were aged 12, 12 and 13, respectively Three patients were girls

Of 2 patients with jaundice, 2 had familial spherocytic anemia and 1 Laennec's cirrhosis The other 2 had no hematologic or liver abnormality, although 1 had no specific tests for hemolytic anemia Liver biopsy was done only on the patient with Laennec's cirrhosis Cholecystectomy was performed on 3 patients In the patient with spherocytic anemia, splenectomy was done, and the gallbladder was found to be thin-walled, soft and pliable, containing several small, millet-seed sized soft stones It was thought likely the stones would pass, hence, the gallbladder was not removed

Cholelithiasis in childhood is rare, but in patients with unexplained abdominal pain or jaundice, it should not be forgotten in differential diagnosis, particularly since accurate diagnosis by cholecystography is simple and surgical results are excellent Presence of jaundice is far more commonly due to hepatocellular disease in children, but the possibility of cholecystitis, with or without cholelithiasis, should be kept in mind Cholecystic disease is a complication of more than 50% of patients with hemolytic jaundice It does not follow that patients with cholecystic disease have a high incidence of hemolytic disease In one report, 40 patients under age 25 had cholecystic disease, but only 2 (5%) had hemolytic disease

Acalculous Gallbladder The surgeon confronted with a nonacutely inflamed gallbladder without stones at an operation undertaken for presumed biliary tract disease has a difficult decision Evaluating 121 patients subjected to cholecystectomy whose gallbladders were not acutely inflamed and did not contain stones, Frank Glenn and Henry Mannix, Jr[6] (New York Hosp) found that a good result was attained in 65%, some improvement in 11% and no improvement in 24% Among 135 cases, there were 22 (16 3%) serious postoperative complications, followed by 3 deaths However, the surgeon may anticipate that an occasional patient whose gallbladder is left unmolested will continue to have symp-

(6) Ann Surg 144 670 680 October, 1956

toms and that later gallstones may be shown by cholecystography Careful pathologic review showed that gallbladders from 65% of the patients who were relieved of symptoms after cholecystectomy were so similar to those from persons with persistent symptoms that the actual role of cholecystectomy in clinical improvement is questionable

More careful evaluation of x ray examinations of the biliary tract will probably reduce the number of patients who when operated on will unexpectedly be found not to have stones For further evaluation, biliary drainage should be done Cholesterol crystals in the collected specimen are strong evidence for calculous disease, whereas their absence should induce caution regarding diagnosis of chronic cholecystitis

Sometimes it is difficult to decide whether the gallbladder is normal Small stones may not be palpable particularly if the gallbladder is not empty of bile Occasionally small stones can be palpated in the ampulla only after careful emptying by compression Likewise a small stone may sometimes be palpated in the cystic duct although none are evident in the gallbladder The thickened wall of cholesterosis or strawberry gallbladder may be indistinguishable from the normal in a large or obese patient

► [It would have been desirable to include in this study a control series of patients in whom th [illegible]
error in diagnosis [illegible]
that careful patholo[illegible]
were relieved of symptoms after cholecystectomy revealed them to be so similar to those removed from individuals who had a persistence of symptoms that one may well question the actual role of cholecystectomy in the clinical improvement —Ed]

Clinical Study of 1,060 Patients with Acute Cholecystitis is presented by Walter F Becker Joseph L Powell and Robert J Turner[7] (Louisiana State Univ) This study group included 205 males and 855 females aged 6 92 Patients over 60 comprised 28 1% of the group and 72 1% of the deaths About 56% of the patients had had symptoms of acute cholecystitis for 48 hours or less before hospitalization In 25% there was no past history suggesting biliary tract disease Cholelithiasis was present in 88 1% of the patients treated by surgery and choledocholithiasis in 8 6% Of the 679 patients having laparotomy 65 (9 3%) had a perforated gallbladder No surgery was done in 36% of the patients cholecystostomy

(7) Surg Gynec & Obst 104 491 496 April 1957

was done in 8 1%, cholecystectomy in 41% and cholecystectomy and choledochostomy in 13 2%

The over-all mortality was 6 4%, but nonoperative treatment was attended by a mortality of 5 5% Errors in diagnosis contributed to more than half of the deaths The mortality for cholecystectomy was 3 9% During the second half of the period under study 308 patients had this operation, with a mortality of 1 9% The high mortality rate of 15 6% associated with cholecystostomy was not unexpected in view of the type of patient for whom the operation was selected In 140 patients treated by cholecystectomy and choledochostomy, the mortality was 7 9%

Since 20% of the operations included choledochostomy and stones were found in only 31 6% of the ducts explored, and since the addition of common duct exploration doubled the risk of operation, it is suggested that in certain patients with acute cholecystitis, the less urgent indications for performing choledochostomy should be disregarded

Common Duct Exploration in Acute Cholecystitis is discussed by Frank Glenn and George Johnson, Jr [8] (New York Hosp -Cornell Med Center) In acute cholecystitis, a specific indication for choledochotomy is required and the procedure must not be undertaken haphazardly Jaundice alone is not necessarily an adequate indication However, in patients who have had repeated attacks of jaundice, progressive jaundice or a markedly elevated bilirubin level, the common duct should be explored Exploration also should be performed if the following conditions are present (1) a stone or stones palpated within the ductal system, (2) distention of the common duct, (3) edema about the head of the pancreas (if present with any other indication for exploration) and extensive induration of the pancreas, and (4) small stones in the gallbladder or cystic duct

Palpation of stones and evaluation of induration or dilatation of the common duct and cystic duct may be difficult because of edema and thickening of surrounding tissues If there is any question in the surgeon's mind regarding evaluation of the cystic or common duct, these structures should be exposed

(8) Surg Gynec. & Obst 104 190 199 February 1957

Choledochotomy carries an increased postoperative morbidity 18% of the authors' patients had postoperative complications Increasing the period of anesthesia and the further dissection of inflamed tissues required in performing choledochotomy add to the number of complications There were 2 deaths in this series of 83 cases, a mortality of 2 4%

Cholecystostomy in Modern Surgery Cyril Costello[9] (St Louis) reviewed 72 cholecystostomies performed by 55 surgeons Most patients were critically ill and three fourths were over age 60 There were more men than women Postoperative mortality was 30%, the high rate reflecting the critical state of most patients However, it also appeared that in some instances the operator's desire to explore further than the gallbladder may have interfered with the localizing processes of defense already established In other patients unusually long downhill courses were observed during hospitalization before a decision to drain the gallbladder was reached

The commonest indication for the operation was acute cholecystitis The gallbladder was not removed either because severe debility interdicted the added risk of cholecystectomy or because technical difficulties of cholecystectomy in the presence of brawny *inflammatory reaction* were too hazardous

In 11 patients cholecystostomy was performed as a primary decompression procedure in carcinoma of the gallbladder or bile duct or for acute pancreatitis As an ancillary procedure to other operations it was performed on 5 patients with satisfactory results Of 39 patients who survived cholecystostomy for acute cholecystitis, 8 (20%) subsequently underwent operation for removal of the organ Elective removal was performed in 5 3 of them (all over age 70) returning for removal of the gallbladder as an emergency procedure in attacks of recurrent acute cholecystitis Patients undergoing cholecystostomy for acute cholecystitis should later have elective cholecystectomy if they have reasonable life expectancy and no serious medical contraindications to operation

Further Considerations in Evaluation of Primary Closure of Common Bile Duct Following its Exploration J Lyn

(9) Am. Surgeon 22 1079 1094 November 1956

wood Herrington, Jr, Royce E Dawson, William H Edwards and Leonard W Edwards[1] (Vanderbilt Univ) compared the postoperative courses of 180 patients in whom the common duct was closed after exploration with those of 89 patients in whom the common duct was drained with a T tube or soft rubber catheter Ages were similar in the two groups In the former group, the postoperative hospital stay averaged 11 5 days and in the latter, 16 3 days Many patients in whom the common duct was closed left the hospital on the 6th to 8th postoperative day, with no greater morbidity than patients with simple cholecystectomy in whom duct exploration was not performed Morbidity was definitely increased in patients who had T tubes in the common duct Whereas the usual minor postoperative complications were about equal in the two groups, the significant postoperative complications were somewhat greater in the group with T tube drainage Of the 180 patients undergoing closure of the common duct, 7 died, 4 were elderly persons with pre existing cardiovascular disease Among the 89 patients in whom the common duct was drained, there were 9 hospital deaths, partly due to cardiovascular disease in advanced age

Closure of the common duct, following its exploration, appears to have decided merit Thorough exploration of the hepatic ducts and common bile duct, graduated dilation of the ampullary sphincter with up to a 7 or 8 mm Bakes dilator and meticulous suture of the choledochotomy incision, insure a more physiologic drainage of the extrabiliary apparatus than can be obtained with the T tube The most important prerequisite to closure of the common duct is the establishment of complete patency of the ampulla of Vater

► [This experience indicates that primary closure of the common duct may be accomplished with low mortality and morbidity However the authors fail to state the respective indications for primary closure and for T tube drainage after exploration The factors influencing the selection of one or the other method may contribute more to the mortality and morbidity than these forms of treatment —Ed]

Stenosis of Sphincter of Oddi Richard B Cattell, Bentley P Colcock and Jerome L Pollack[2] (Lahey Clinic) reviewed 67 women and 33 men with stenosis of the sphincter of Oddi and stricture of the papilla of Vater This condition may

(1) Ann Surg 145 153 161 February 1957
(2) New England J Med 256 429-435 Mar 7 1957

cause repeated attacks of severe pain in the right upper quadrant with or without jaundice or dilatation of the common duct. If unrecognized and not corrected at the initial operation, symptoms may persist which will require reoperation Exploration of the common duct is incomplete unless obstruction at the ampulla of Vater is ruled out. Preoperative intra-

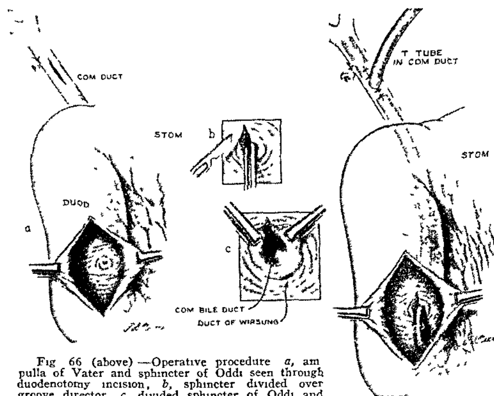


Fig 66 (above) —Operative procedure *a*, ampulla of Vater and sphincter of Oddi seen through duodenotomy incision, *b*, sphincter divided over groove director, *c*, divided sphincter of Oddi and opening of duct of Wirsung

Fig 67 (right) —Long arm T tube in place before duodenotomy incision is closed (Courtesy of Cattell, R B, *et al* New England J. Med 256 429 435, Mar 7, 1957)

venous cholangiography permits being forewarned of this possibility at choledochostomy Partial obstruction of the common duct due to stenosis of the sphincter of Oddi may cause development of common duct stones.

Transduodenal sphincterotomy with implantation of a long-arm T tube in the common duct was performed in 72 patients. The lower end of the transverse limb of the tube is left long and brought down the common duct through the divided sphincter into the third portion of the duodenum (Figs. 66 and 67) A short-arm T tube was used for drain-

age in a patient who had sphincterotomy Choledochostomy with forcible dilatation of the sphincter by graduated Bakes dilators was done in 26 patients One patient had a choledochojejunostomy, another a choledochoduodenostomy

Of 73 patients in whom transduodenal sphincterotomy was done, 67 had no complications, mortality was 2% During an average follow-up of 1½ 2 years, 81 patients had no symptoms

Cancers of Gallbladder Revealed by Histologic Examination after Cholecystectomy for Lithiasis E Delannoy, G Lagache, J Devambez and Y Godefroy-Vendeville[3] (Lille) report that in 5 of 17 cases of cancer of the gallbladder, malignancy was not suspected clinically or at operation, and diagnosis was made only by microscopic examination of tissues removed All 5 patients had stones, and 4 had acute cholecystitis—in 1 accompanied by jaundice The gallbladder was enlarged in the patient without acute inflammation Four patients were women, aged 48 77, 1 was a man, aged 73 Three had had previous hepatobiliary illness, probably due to stones, 3 13 and 57 years before appearance of cancer In 1, the first sign was acute cholecystitis only a month before operation Pathologic diagnosis in 4 was glandular epithelioma of a biliary type, and in 1, malpighian metaplastic epithelioma All gallbladders showed purulent inflammation and necrosis except 1 with neoplastic infiltration in a sclerotic stroma which macroscopically simulated chronic hypertrophic cholecystitis Four patients died 1-18 months after operation, the other could not be traced

These masked cases of cholecystic cancer constitute an argument for cholecystectomy instead of cholecystostomy in cholelithiasis, especially with acute cholecystitis, whenever it is technically possible or does not incur excessive risk to life The cases also indicate that careful histologic examination should be made of all gallbladders removed at operation Because of the importance of cholelithiasis in cancer of the gallbladder, the authors recommend preventive surgery for cholecystic cancer They advise cholecystectomy systematically in all cases of cholelithiasis, even those which are asymp-

(3) Lyon chir 51 421-434 May June 1956

tomatic Operation is especially important when medical treatment is ineffective or contraindicated because of the size of the stones or because of parietal sclerosis Secondary removal of the gallbladder should follow cholecystostomy performed for acute cholecystitis in aged patients

► [Carcinoma of the gallbladder is found in approximately 1% of patients undergoing cholecystectomy The main indications for cholecystectomy are the nonmalignant complications of calculous disease rather than the danger of cancer as emphasized by these authors —Ed]

Carcinoma of Extrahepatic Bile Ducts · Review of Literature and Report of Six Cases Kumao Sako, Grover L Seitzinger and Earl Garside[4] (Augustana Hosp Chicago) found 564 cases of carcinoma of the extrahepatic bile ducts satisfactorily reported in the literature To these, they added 6 of their own The reported autopsy incidence varied from 0 012 to 0 458% The reported incidence in biliary tract surgery ranged from 0 3 to 1 8% and the incidence in all malignancies found at autopsy from 2 88 to 4 65% Gallstones were found to coexist in only 38 7% of the cases The ratio of men to women was about 3 to 2 Age range was 20 89 years, with an average of 59 2

The principal signs and symptoms indicated biliary obstruction Jaundice usually occurred within 4 months before hospitalization and was progressive in 73-100% Pain pruritus weight loss, vomiting anorexia fever, diarrhea nausea constipation and chills were frequently noted The presence of a palpably enlarged liver more closely paralleled the biliary obstruction than did gallbladder enlargement Cystologic studies on duodenal aspirations alone, of all the laboratory procedures, offer promise of a definitive preoperative diagnosis

Distribution of the 570 bile duct carcinomas was as follows hepatic ducts, 47, common hepatic duct, 79, triple junction, 137 cystic duct, 34, common bile duct, 203 and unclassified, 70 Grossly, the tumors were found to be either a nodule, a papillary tumor a stricture or a diffusely infiltrating lesion According to the authors' classification, 369 were differentiated adenocarcinomas 48 undifferentiated adenocarcinomas, 1 was a hornifying squamous cell carcinoma,

(4) Surgery 41 416 437 March 1957

and 6 were nonhornifying squamous cell carcinomas The liver and regional lymph nodes were the commonest sites of metastases Frequent invasion of the regional nerve plexuses was also noted

Results of surgical treatment of extrahepatic bile duct carcinomas have been uniformly poor Various types of external drainages, shunts and anastomoses between the biliary and gastrointestinal tracts have been described Longer survival periods were obtained for tumors of the junction and the common duct with radical procedures, which consisted of block resection of the involved portion of the duct and reestablishment of biliary tract continuity In 172 patients treated surgically the average survival period was 4 2 months

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THE PANCREAS

Annular Pancreas is a congenital malformation in which a band of pancreatic tissue surrounds the duodenum, generally the second portion, above the ampulla of Vater The presence or absence of symptoms of duodenal obstruction depends on the degree of constriction caused by the pancreatic ring Many cases are unrecognized, being discovered incidentally at autopsy or at operations done for other reasons The condition is relatively rare but undoubtedly occurs more frequently than the statistics indicate A review to the end of 1955 revealed 85 cases, most of them reported during the last decade About 50 patients were treated surgically and 6 were diagnosed preoperatively Federico E Christmann, Fidel Schaposnik and Jorge H Deschamps[5] report an additional case

Girl, 15 had had moderate intermittent epigastric pain for 6 months which was unrelated to meals lasted a few minutes and was not accompanied by vomiting though there was occasional nausea Pain appeared in episodes lasting several days with free intervals of 1-2 weeks She had lost 2 5 kg Appendectomy had been performed 10 months earlier Palpation of right epigastrium and right hypochondrium produced intense pain with discrete muscular rigidity Mur

(5) Soc cir Buenos Aires 40 [illegible] 2 285 1956

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(5) Soc cir Buenos Aires 40 272 285 1956

phy's sign was definitely present On palpation of the descending spastic colon, there was moderate pain in the left flank

Serial gastroduodenal x-rays showed a normal duodenal bulb, with a diverticulum in the second segment which was extremely painful to palpation

Surgical exploration through a pararectal incision revealed that the second duodenal segment was bound with adhesions, connecting it with the gallbladder, right angle of the colon and the greater omentum After the adhesions were freed, a band about 1 cm thick (wider at the ends) originating from the pancreas was found strangulating the middle portion of the second duodenal segment with which the diverticular pocket was continuous The ring extended without interruption of its continuity from the anterior surface of the head of the pancreas around the duodenum to the posterior surface of the head of the pancreas The duodenal diverticulum was evidently the result of pressure, due to stenosis induced by the annular pancreas The pancreatic ring was dissected and completely removed, thus freeing the constricted duodenum which recovered its normal appearance during operation Cholecystectomy also was performed, and the abdomen was closed without drainage

Histologically, the gallbladder was moderately edematous with hypersecretion and desquamation of the mucosa Other tissue removed was normal pancreas

Pancreatography—Indications and Observations According to Henry Doubilet, Maxwell H Poppel and John H Mulholland[6] (New York Univ), pancreatography during abdominal operations is no more difficult than operative cholangiography and is without danger It requires sectioning the sphincter of Oddi transduodenally and inserting a fine plastic tube for 4-5 cm into the opening of the pancreatic duct found in the posterior wall of the ampulla of Vater Drainage of the pancreatic duct is shown in Figure 68

When *acute inflammation was absent, only* the larger duct system of the pancreas was delineated, but with early edema finer ducts became visible and the whole pancreas was outlined faintly In acute inflammation, the whole pancreas was opacified

Pancreatographic studies were of value to determine presence of acute inflammation or edema, to opacify the whole pancreas deliberately and to demonstrate dilatation of ducts, cysts cystic dilatations and pseudocysts, patency of the main pancreatic duct, complete absence of a connection between the main pancreatic duct and a cyst and obstruction of the

(6) J A M A 163 1027 1030 Mar 23 1957

pancreatic duct by utilizing the accessory pancreatic duct.
Roentgenograms were obtained showing pseudocyst of the pancreas, dilatation of the pancreatic duct resulting from partial obstruction by calculi, stenosis of the pancreatic duct

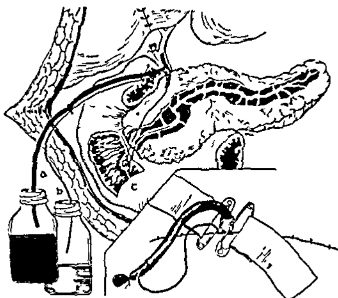


Fig 68 —Polyvinyl tube (*b*) passes alongside T tube (*a*) through lower end of T lying in common duct through cut sphincter of Oddi (*c*) and up pancreatic duct Bile and pancreatic juice are collected separately After 4 days, T tube is *tied and* polyvinyl tube inserted into it by means of needle (*inset*), allowing pancreatic juice to circulate back into duodenum In absence of T tube, plastic tube is brought out through cystic duct (Courtesy of Doubilet, H, *et al* J A M A 163 1027 1030, Mar *23, 1957*)

after splenectomy and obstruction of the duct after operation for a large pseudocyst

► [Th... ributions to our knowl... triking demonstration of

Experimental Functional Manometric and Radiographic Exploration of Wirsung's Canal: I. Nervous Mechanism of Regulation of Pressure in Pancreatic Duct. P Mallet-Guy, L Durand, R Vidil and P Mounet[7] attempted to discover how manometric and radiographic technics used in biliary surgery could be adapted to study of the pancreatic excretory apparatus in the dog Because of the small size of the duct, a factor of capillarity was introduced in the manometric studies, which was overcome by injecting air instead of sa-

(7) Lyon chir 51 393 410, May June, 1956

line solution Radiographic examination yielded good descending pancreatography, but often interpretation of the films was uncertain Changes of pressure less than 3 cm water in manometric studies were not regarded as significant Normal pressure of Wirsung's canal was variable, but fixed arbitrarily between 12 and 18 cm water Pressures over 20 and under 10 were regarded as abnormal Of 120 experiments 87 were satisfactory

In 5 experiments, the hypotonic effect of 0 25 0 50 mg atropine appeared constant, it was evident immediately and was transient Among 5 dogs receiving Pro-banthine® intravenously, pressure was definitely reduced in 3 by at least one third, and in 2 of these the effect lasted 10 minutes or more In the others hypotonic effect was less pronounced Among 13 dogs receiving 1 cc Prostigmine® intravenously, pressure was increased promptly in 12, and increase was durable (10 minutes) in 6 In 1 experiment, a countertest with atropine demonstrated repeated effect of Prostigmine® Effect of morphine is not so constant or definite In 4 experiments epinephrine showed no significant effect

These pharmacodynamic experiments indicated that vagolytic drugs decrease and vagotonic drugs increase the tonus of Wirsung's canal and its sphincter, i e, that maintenance tonus depends on vagal innervation In further experiments low vagotomy produced a hypotonic effect on the gallbladder and pancreas, but results did not agree in some experiments, apparently due to anomalies of nerve distribution Experiments attempting to determine effect on pressure in Wirsung's canal of sympathetic stimulation were beset with difficulties that tended to falsify results Apparently, however, the sympathetic nerves have a hypotonic effect on the excretory system of the pancreas and in 50% of the experiments definite reduction in pressure was registered This was more often obtained by excitation of the left sympathetic (65%), and reductions in pressure were also more marked and prolonged than in similar experiments on the right side

Clinical Studies of Natural History of Acute Pancreatitis are reported by Van G Kaden and John M Howard[8] (Baylor Univ) in a follow-up of 100 consecutive patients treated

(8) A M A Arch Surg 73 269 271 August 1956

for acute pancreatitis during 1949-54 Diagnosis was based mainly on the clinical syndrome and an elevated serum amylase concentration In a few, diagnosis was made at laparotomy Patients were treated for the primary acute illness on a conservative nonoperative regimen, discharged and often lost until they returned with a second attack or until the follow-up program was developed

Pancreatitis is a recurrent disease Of the 100 patients without definitive therapy followed, 39 had recurrences of acute attacks Two patterns were discernible that of patients with stones in the gallbladder or common duct, and that of patients without demonstrable biliary tract disease Acute attacks tended to recur in both groups if patients were untreated Average age at onset in both groups was the 5th decade Seventy-five per cent of the 36 patients with gallstones were women, in the nongallstone group, the sex ratio was 1 1 In the latter group, the incidence of chronic alcoholism was 37% Late sequelae were different in the two syndromes Of patients with normal gallbladders, 16 and 8%, respectively, had pancreatic calcification and pseudocyst formation In no patient with gallstones did a pseudocyst develop, and the only patient in whom a calcification developed was an alcoholic

Of patients with gallstones, 30 had cholecystectomy and choledochostomy A patient with one previous attack of pancreatitis had an attack of pain 3 months after cholecystectomy, serum amylase was normal The patient has remained asymptomatic for the ensuing 4 years Thus, only 3% of patients who had gallbladder surgery for gallbladder disease had recurrences However, of 9 patients without gallbladder disease who had cholecystectomy and choledochostomy, 3 had recurrences This approximates the natural incidence of recurrence Definitive gallstone surgery appears to interrupt the course of associated pancreatitis, if gallbladder disease is present Removal of the normal gallbladder does not appear to influence the incidence of recurrence

On the basis of the natural course of the disease therapy consists of initial nonoperative treatment Thereafter, cholecystograms are performed until the gallbladder is visualized or until nonvisualization persists for at least a month after

the acute attack Cholecystectomy and choledochostomy are recommended *only for patients with gallstones*

Survey of Experiences with 300 Clinical and 108 Autopsy Cases of Acute Pancreatitis is presented by Ram A Joshi, J G Probstein and Herman T Blumenthal[9] (St Louis) who distinguish the following types of acute pancreatitis transient, characterized by transient elevation of serum diastase values and complete recovery without complications, secondary, due to extension of an inflammatory process from another site fulminating, or acute hemorrhagic, accompanied by marked shock and terminating fatally, terminal characterized by a mild form of acute interstitial pancreatic *inflammation and small foci of fat necrosis discovered incidentally* at autopsy, with death usually due to cardio or cerebrovascular disease

No single etiologic factor can explain all cases of acute pancreatitis About 8-10% appear to develop on a "common channel" basis, 10% on an infectious basis and about 10% on a toxic, metabolic or traumatic basis Chronic gallbladder disease with lithiasis does not appear to have an increased frequency in acute pancreatitis *In almost two thirds of the* patients the etiology is unknown

Abdominal pain was present in almost all patients, but abdominal rigidity occurred only in 1 of every 6 Fever, 100 104 F, occurred in about half the patients, vomiting in a third jaundice in a fifth and common duct *obstruction in* about 8%

Treatment of choice, particularly in transient and fulminating *pancreatitis is conservative* and supportive The com*mon channel type and those types of infectious* pancreatitis secondary to a perforated viscus should be treated surgically

The authors suggest that chronic relapsing pancreatitis with stone formation is a separate entity, with etiology and *pathogenesis* unrelated to acute *pancreatitis*

Relapsing Pancreatitis Secondary to Choledocholithiasis John M Howard and George L Jordan Jr,[1] in a review of about 200 patients with acute pancreatitis, found that at least 40% had more than one attack Four repeatedly had

(9) Am Surgeon 23 34 42 January 1957
(1) A M A Arch Surg 73 960 964 December 1956

classic attacks until a common duct stone was identified and removed. None of these patients was alcoholic; only 1 patient, on one admission, had symptoms suggestive of partial obstruction of the common duct. Each patient was treated by cholecystectomy and choledochotomy. There were no postoperative complications. All were asymptomatic up to 18-36 months after surgery.

From the literature, information was obtained on 29 patients with relapsing pancreatitis and common duct stones who were followed 18 or more months after treatment. With the inclusion of the authors' 4 patients, data were available on 33. Surgery for common duct stones resulted in complete relief from symptoms in 27 (82%), partial relief in 4 (12%) and no improvement in 2. If these data represent an accurate sampling, the results obtained are superior to those reported after treatment of patients without common duct stones.

A common duct stone may be a definite etiologic factor in producing recurrent attacks of pancreatitis. When biliary calculi are present with pancreatitis, a thorough exploration of the common duct is indicated at an elective period.

Significance of Pancreatic Calcification. Maurice L. Kelley, Jr., Lucy F. Squire, Lyman C. Boynton and Victor W. Logan[2] (Univ. of Rochester) present data on 31 patients with x-ray evidence of pancreatic calcification, which was confirmed by autopsy in 6. Abdominal pain, representing attacks of pancreatitis, was present in 17. This group had the highest incidence of pancreatic dysfunction, as indicated by diabetes mellitus, steatorrhea and impaired absorption of vitamin A. Of the other 14 patients, 6 had minor abdominal symptoms, possibly related to pancreatitis, and 4 had no gastrointestinal complaints. In 4, the pancreatic element of pain could not be clearly evaluated because of coexisting gallbladder disease or peptic ulcer.

The degree and extent of calcific deposits in the pancreas were related to the degree of pancreatic dysfunction, but not to the severity of abdominal distress. Serum amylase determinations were of little help in indicating pancreatic disease, probably because of destruction of so much of the acinar tissue of the gland. A decrease in frequency and severity of

(2) New York J. Med. 57:721-730, Feb. 15, 1957.

abdominal pain occurred in a number of patients after the appearance of calcification, reflecting a "burning out" of the inflammatory process

Patients who had surgery benefited from biliary tract decompression and cholecystectomy, splanchnicectomy and pancreatolithotomy

The major complications encountered were diabetes mellitus, steatorrhea gastrointestinal hemorrhage, peptic ulcer tuberculosis and inflammatory mass in the head of the pancreas

There were 6 deaths Two were due to tuberculosis 2 to massive hemorrhage, 1 to hepatic coma and 1 to subdiaphragmatic abscess after cholecystectomy

Calcification of the pancreas is significant only when it causes pain or is accompanied by pancreatic insufficiency

Pancreatic Function Studies before and after Thoracolumbar Sympathectomy and Splanchnicectomy for Chronic Relapsing Pancreatitis Robert B Pfeffer and J William Hinton[3] (New York Univ) treated 5 consecutive patients by thoracolumbar sympathectomy and splanchnicectomy 2 bilateral and 3 unilateral for relief of intractable abdominal pain from chronic relapsing pancreatitis Four patients were examined preoperatively by the secretin-duodenal drainage test and values for volume, bicarbonate concentration and amylase produced were in the diagnostic range of chronic pancreatitis, confirming the clinical impression All had the secretin duodenal drainage test postoperatively

All 5 patients are clinically well after an average postoperative follow up of 3 years None has any abdominal pain similar to that present before operation There is no x ray evidence of development of pancreaticolithiasis and none has pseudocyst formation The secretin duodenal drainage test was performed an average of 2 years 2 months postoperatively in 4 patients and 4 years after surgery in 1 In 3 there was diminution of exocrine function of the pancreas in response to the hormone secretin, 1 was about the same, and only 1 had improvement in exocrine pancreatic function after unilateral sympathectomy, splanchnicectomy and celiac ganglionectomy

► [Splanchnicectomy relieves the pain of chronic pancreatitis in some pa

(3) Surgery 40 311 319 August 1956

tients for varying periods but there is no evidence that it has any direct or beneficial influence on the disease process —Ed]

Technic of Surgery of Oddi's Sphincter is described by Marcel Roux and R Rettori[4] (Paris) as the treatment of choice for sclerous odditis and as useful in certain cases of chronic pancreatitis with retention

TECHNIC —After a reverse L incision is made, careful exploration is carried out to determine the state of the liver, hepatic pedicle and duodenopancreatic block The operative technic differs slightly according to whether the indication for sphincterotomy is biliary or pancreatic For the biliary type, preliminary radiomanometry is done, by the transcystic route if the gallbladder is to be sacrificed if not, the common bile duct is entered directly After a choledochal incision and extraction of any stones, the duct is explored by an S shaped catheter, at the end of which is an olive shaped perforated sound The catheter is inserted into the common bile duct until the olive is evident under the duodenal wall The anterior wall of the 2d duodenal segment is seized with 2 Chaput forceps and the duodenum incised longitudinally for 3-4 cm Tension sutures, to be used later for fixation of the papilla, are applied to both edges of the duodenal incision and retractors are inserted above and below After location and exposure of the papilla, it is sectioned as the 1st stage of the sphincterotomy The papilla is incised for about 5 cm at its superior pole over the support furnished by the sound attached to the S-shaped catheter The common sphincter is thus sectioned and the common duct opened If this canal does not exist because of a long mucous spur separating the lumen of the 2 ducts at the papillar orifice, the choledochal terminal is opened directly The edges of the choledochal mucosa are immediately identified and fastened to the edges of the duodenal mucosa By tension on the sutures, the papillary incision is exposed and Wirsung's canal can be visualized below and above at the lower edge of the intercanicular mucous spur This papillotomy, which has permitted sectioning of the common sphincter, should be completed by sectioning of the choledochal sphincter proper To avoid undesirable adhesions, transpapillary drainage is necessary An ordinary no 20 or 25 drain is placed under the liver The abdominal wall is closed in 3 layers Whether a Voelcker drain or a Cattel tube is used for transpapillary drainage, this is maintained for 17 days A much longer period, advocated by some authors, is neither necessary nor desirable

Of 24 sphincterotomies done by the authors, 21 had biliary indications One death occurred, due to a technical error of inserting the catheter into Wirsung's canal instead of the common duct after injection of a contrast substance Acute pancreatitis supervened, but this patient also presented a

(4) J chir 72 761 777 November 1956

pylethrombosis and a complex clinical picture generally Nevertheless, acute pancreatitis represents the most serious complication postoperatively, and was the cause of 3 of 4 deaths in 47 sphincterotomies (including the present cases) reported by Rettori Sphincterotomy is a delicate and difficult operation which should not be used without good reason It is more serious than a simple choledocoduodenal diversion of the Sasse type, which is preferable if patients are in poor condition

Experience with Resection of Pancreas in Treatment of Chronic Relapsing Pancreatitis Most indirect and less radical surgical procedures for chronic relapsing pancreatitis have failed William P Longmire, Jr, Paul H Jordan, Jr and John D Briggs[5] (Los Angeles) treated 8 patients who had chronic relapsing pancreatitis by radical resection of the pancreas

Indirect surgical procedures had been used 41 times in 26 patients Of 19 patients available for follow up results were good in only 2 who had cholecystostomy and cystogastrostomy, equivocal in 1 with pancreatic duct ligation and poor in the other 16 Sphincterotomy was the commonest procedure and produced satisfactory results in only 1 patient

Patients were selected for resection of the pancreas if they had recurrent attacks of abdominal pain with elevated serum or urine amylase and if the frequency of attacks increased and abdominal pain persisted between episodes Marked architectural changes in the pancreas were suggested by absence of serum amylase elevation during an attack of pain when formerly this had occurred, calcification in the region of the pancreas, onset of diabetes weight loss increase in frequency and bulk of the stool and in its fatty character, failure to obtain a positive secretin test and the gross appearance of the pancreas at laparotomy

Removal of the architecturally destroyed pancreas with its distorted and obstructed duct system is a better surgical approach than indirect measures The nutritional and metabolic changes associated with total pancreatectomy are so marked that the procedure should not be performed unless the functional capacity of the entire gland has been severely

(5) Ann Surg 144 681 695 October 1956

involved in the destruction Pancreaticoduodenectomy was performed in 5 patients and total pancreatectomy in 3 There was no immediate mortality, but 1 patient died 4 months after operation Of the other 7 cases, with follow-up ranging from 6 months to 5½ years, the results were excellent in 5 and improved in 2

These results are promising and further study is indicated Resection of the pancreas is the current treatment of choice for far-advanced, chronic, relapsing pancreatitis with duct obstruction Patients should be selected before they become addicted to narcotics The caudal end of the pancreas should be retained if possible, though inflammation and fibrosis may be present The greater morbidity and mortality and the magnitude of the nutritional and metabolic defects of total pancreatectomy justify the risk of recurrent pancreatitis which results from retaining this end portion of the organ

► [It is generally agreed that elimination of biliary tract pathology is essential for relief of symptoms of chronic pancreatitis However, if no disease of the biliary tract is present the proper surgical approach to the man- [illegible] atter of dispute The results [illegible] e encouraging, since others [illegible] pancreatectomy Surgeons having wide experience with pancreatic surgery are now able to perform this procedure without undue hazard to the patient, though in the hands of the occasional operator such a procedure will still be attended by high rates of mortality and morbidity Total pancreatectomy is followed by serious metabolic derangements which frequently disable the patient severely Therefore this procedure cannot be recommended —Ed]

Pseudopancreatic Cysts Their Diagnosis and Treatment; Analysis of Eight Cases Pseudo-pancreatic cysts are collections of pancreatic secretions and serous exudates in the lesser peritoneal sac They have no epithelial lining, their walls being formed by the peritoneum of the lesser sac Although their origin is closely related to pathologic changes within the pancreas, they differ from true pancreatic cysts in not being located within the pancreas S S Anand and C P Sawhney[6] (Amritsar, India) report 8 cases of pseudocysts

Pancreatitis is most often the forerunner of pseudopancreatic cyst This was true in 7 of the authors' cases Generally attacks preceding pseudocyst formation were acute, lasting for several days Only 1 patient had a history of trauma

(6) Indian J Surg 18 174 184 June 1956

Pseudocysts usually appear a few days after the acute episode of pancreatitis. In 6 cases they were first noticed within a week. They may, however, form slowly. Further increase in size is rapid, quite independent of further attacks of pancreatitis; if it is unchecked, the pseudocyst may burst, with fatal consequences. In 6 cases the mass was mainly epigastric, occupying the whole upper half of the abdomen. Pain and a mass in the upper abdomen were the chief complaints. Repeated estimations of serum and urinary amylase in 6 cases showed elevations in all, whether there was pain or not. Readings dropped to normal soon after drainage.

Plain x-rays of the abdomen revealed only a diffuse radiopaque mass in the upper abdomen. On barium study, the stomach was often displaced downward and forward against the anterior abdominal wall. In 2 cases there was widening of the duodenal loop. Another finding was the persistent pressure effect on the duodenal cap, pyloric antrum and body of the stomach.

Early operation is indicated to avoid spontaneous rupture. Marsupialization is useful, but internal drainage into some hollow viscera in the gastrointestinal tract is preferable. Internal drainage into a defunctionalized loop of jejunum (Roux en Y loop anastomosis to jejunum) is the method of choice, as it obviates risks of entrance of intestinal contents into the cyst.

Cystadenoma and Related Nonfunctional Tumors of Pancreas: Pathogenesis, Classification and Significance were studied by George G. Glenner and G. Kenneth Mallory[7] (Boston City Hosp.) in 35 cases. The nonfunctional adenomas of the pancreas were classified as (1) duct adenoma, (2) acinar adenoma, (3) mixed adenoma and (4) fibroadenoma. The duct adenoma may be a cystadenoma or a solid duct adenoma. The cystadenoma may be simple or papillary.

The pancreatic cystadenoma is derived from neoplasia of pancreatic ducts, and it is hypothecated that solid duct cell adenomas originate deep in the pancreatic parenchyma, whereas cystic duct adenomas (cystadenomas) are formed peripherally. The papillary cystadenoma is a potentially or actually malignant tumor often showing early recognizable

(7) Cancer 9 980-996, Sept-Oct, 1956.

evidence of invasive spread by cellular infiltration of the perineural lymphatics Acinar adenomatous hyperplasia may be an incipient malignant change of the acinar cells of the pancreas and may readily transform into an acinar cell carcinoma The pancreatic duct cell is the cell most often a component of pancreatic neoplasms

Ulcerogenic Tumor of Pancreas Edwin H Ellison[8] (Ohio State Univ) describes 24 patients with a new clinical syndrome consisting of a fulminating and often fatal peptic ulceration associated with a noninsulin-producing islet cell tumor of the pancreas Fourteen were single and 10 multiple tumors The entire pancreas was involved in 3, the head and body in 2, the body and/or tail in 12 and the head of the pancreas alone in 4 One tumor arose in aberrant pancreas tissue in the stomach wall Although 19 of the tumors were malignant, growth was slow and peptic ulceration remained the predominant manifestation in nearly all patients Only 11 of the 19 had spread beyond the confines of the pancreas

The syndrome consisted of a fulminating peptic ulceration characterized by excessive gastric secretions with the 12-hour night secretions often exceeding 2 L and 100 mEq free HC1, *and rapidly progressive, atypically located ulcers* recurring despite adequate medical or surgical therapy

The pancreatic tumor was not recognized until autopsy in 9 patients, who underwent 23 operations for 35 primary and recurrent marginal ulcerations and in each instance died of ulcer, with an average survival time of 17 months The tumor was removed at operation in 11 patients with complicated ulcer disease, and of these, 5 are living Overlooked islet tumors were found in the pancreatic remnant in 3 who died of ulcer The other 3 succumbed to recurrent tumor The average survival time in the 6 fatal cases was 6 6 years and represents a considerable improvement over results obtained in patients in whom the pancreatic tumor was overlooked

Documented observations of the return of gastric secretions to normal levels after resection of a noninsulin producing islet cell tumor of the pancreas in a patient with hypersecretion and recurrent marginal ulcerations suggest that a hormonal or chemical factor arising in the pancreatic

(8) Surgery 40 147 170 July 1956

tumor can stimulate the gastric glands to secrete and may cause the ulcer disease

A careful search of the pancreas should be made in all patients operated on for peptic ulcer, especially those with atypically located primary ulcer or those with recurrent marginal ulceration The operation should include removal of the tumor combined with some standard ulcer procedure designed to protect the patient in the event of recurrent or residual tumor The difficulties encountered in palpating a small pancreatic adenoma suggest that resection of the body and tail of the pancreas may be advisable before a patient is subjected to total gastrectomy as a final, heroic method of controlling the acid factor

► [The concept presented by Dr Ellison is an interesting one Cumulative experience suggests a possible relationship between the pancreatic lesion and ulceration of the gastrointestinal tract However there are not enough data to prove this point definitely This problem requires further evaluation and all cases encountered should be studied in detail to add to the cumulative experience since no one surgeon is likely to encounter many such cases —Ed]

THE ESOPHAGUS

Management of Esophageal Perforations is discussed by Philip E Bernatz [9] The symptoms and signs vary with the location of the esophageal perforation, but pain is predominant in most situations In the cervical region the persistent pain is aggravated by movement of the head and usually accompanied by fever, dysphagia, tachycardia and tenderness on one or both sides of the neck There may or may not be palpable subcutaneous crepitation Perforations of the thoracic esophagus are associated with substernal and upper abdominal pain Early the pain may be minimal and the syndrome of sudden hypotension and respiratory distress may suggest pulmonary embolism

Physical findings of a rigid abdomen may mislead the examiner Palpable subcutaneous crepitation in the cervical region as a result of escaping air through the mediastinum is a reliable sign X ray studies are invaluable in the diag

(9) Proc Staff Meet Mayo Clin 31 6 1 678 Dec 26 1956

nosis of this entity. In event of perforation of the cervical esophagus, lateral views of this region reveal air in the prevertebral space, which may extend up to the base of the skull. The trachea may be displaced anteriorly. Later, a fluid level may be present. With perforations of the thoracic esophagus, there may be mediastinal emphysema or a fluid level in the mediastinum The mediastinum may be widened. Pleu-



Fig 69—Spontaneous perforation of distal portion of esophagus Iodized oil (Lipiodol®) instilled through nasal catheter into esophagus is visible in mediastinum (see arrows) Pleural effusion is present with elevaton of left hemidiaphragm (Courtesy of Bernatz, P E Proc Staff Meet Mayo Clin 31 671 678, Dec 26, 1956)

ral effusion and pneumothorax may be evident on one or the other side, usually on the left side. By insertion of a few cubic centimeters of radiopaque oil through a tube into the upper part of the esophagus or by giving the patient some of this same material to swallow, the site of perforation can usually be demonstrated (Fig 69).

Treatment of esophageal perforations is mainly surgical, preferably simple closure of the perforation. Unfortunately, an early approach to the lesion is not always possible and

later surgical procedures are designed to institute adequate drainage of the associated suppurative process It is difficult to state how many hours pass before such a modification of surgical treatment is necessary but the condition of the tissues at the time of exploration is important

Perforations of the cervical esophagus may be handled with regional or general anesthesia Through an incision along the anterior edge of the sternocleidomastoid muscle on the side where the tenderness is most marked, the esophagus is exposed by retracting the thyroid gland anteriorly and the carotid sheath posteriorly Early in the disease process the perforation can be closed in layers and after the operative site has been irrigated, the wound is closed with only a small Penrose drain emerging from the region of perforation In the presence of suppuration, esophageal tissues are edematous and friable and simple drainage of the paraesophageal space suffices Postoperatively, patients are maintained on intravenously administered fluids for 72 hours and then given clear liquids by mouth

Perforations of the thoracic esophagus are best handled by early closure The perforation is approached through either pleural space, depending on which side has the evident pleural reaction Although some patients are in precarious general condition, it has proved most satisfactory to use general anesthesia with an endotracheal tube in place Adequate oxygen can be given and the patient maintained with minimum anesthesia The intercostal incision is planned in relation to the level of the suspected perforation For perforations at the distal end of the esophagus an approach through the 8th interspace is satisfactory The pleural space is evacuated of its irritating contents after which hypotension and tachycardia may improve remarkably The mediastinal pleura is opened widely and the site irrigated and debrided, as needed The rent in the esophagus is usually apparent If many hours have passed, the layers of the esophagus will be edematous and fused in appearance, however, the mucosa can be identified and is accurately closed with fine chromic catgut Muscle layers are approximated with fine silk sutures The mediastinal pleura is left open and the pleural space drained with an intercostal catheter In case of associated gastric retention, it has been beneficial to leave a transnasal tube in the

stomach for decompression for 24 hours, especially if there is pyloric obstruction If closure is satisfactory, liquids are given by mouth after 72 hours

In patients precariously ill with mediastinal suppuration, a posterior extrapleural mediastinotomy, with local anesthesia, provides good drainage and an intercostal tube can be placed into the appropriate pleural space at the same time, if needed With adequate drainage, patients may respond favorably, and although an esophagocutaneous fistula may result it usually closes without complication

Surgical Treatment of Lye Strictures of Esophagus by Mediastinal Colon Transplant without Resection George L

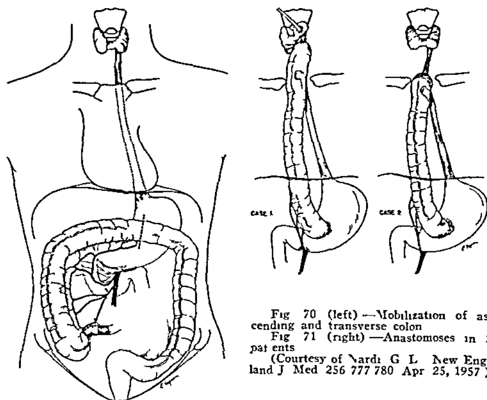


Fig 70 (left) —Mobilization of ascending and transverse colon
Fig 71 (right) —Anastomoses in 2 patients
(Courtesy of Nardi G L New England J Med 256 777 780 Apr 25, 1957)

Nardi[1] (Harvard Med School) performed substernal esophagocologastrostomy without excision of the esophagus in 2 patients with lye strictures of the esophagus The patients were followed for 1 year and both are doing well Case 1 is reported here

Woman, 25, with lye stricture of the esophagus since age 4, had had many bougienages and dilatations X ray study revealed severe

(1) New England J Med 256 777 780 Apr 25 1957

narrowing of the esophagus from the aortic arch to the cardia At surgery the ascending colon was mobilized and the cecum passed anterior to the stomach through a substernal tunnel into the left side of the neck (Fig 70) A cervical esophagocolic anastomosis was done behind the left lobe of the thyroid gland (Fig 71) The distal end of the esophagus was turned in and allowed to retract into the mediastinum The transverse colon was divided to the left of the mid colic vessels which furnished the entire blood supply of the transplant and the proximal colon was anastomosed end to side into the anterior wall of the gastric antrum An old gastrostomy stoma was closed Intestinal continuity was re established by end to end ileo transverse colostomy One year postoperatively barium swallow revealed a normally functioning esophagocologastrostomy and the patient was asymptomatic

► [The advantages of this procedure and the gratifying results achieved provide strong recommendation for its employment in this distressing condition —Ed]

Megaesophagus and Cardiospasm are terms used interchangeably in the literature but Heinz Griessmann[2] believes this is incorrect Differences in these syndromes may be compared to those between Hirschsprung s disease and idiopathic megacolon The multiplicity of terms proposed to describe cardiospasm indicate that the etiology is nonspecific and misunderstood Similarly the many surgical methods indicate disparity in interpretation of the clinical picture

X ray studies disclose distinct patterns in the two conditions In so called cardiospasm the esophagus shows definite widening of the lumen with the flow of barium stopped at the cardia where peristalsis is lacking After a delay of ¼ ½ hour a thin trickle of barium empties into the stomach Retention in the esophagus usually lasts several hours With idiopathic megaesophagus a chest x ray (without contrast medium) often shows dilatation of the mediastinum or a bandlike shadow parallel to the vessels which veers downward near the sternum This indicates the right wall of the esophagus which sometimes is of arm thickness With greater elongation and twisting the lateral border may be arch shaped simulating an aneurysm or mediastinal tumor on the chest plate Mucosal inflammation resulting from chronic stasis may also be revealed roentgenographically by flaky deposition of contrast medium on a sticky mucosa or by absence of folds when the mucosa is swollen The contrast medium empties quickly into the stomach but very large

(2) Thoraxchirurg e 4 34 41 June 1956

amounts remain in the esophageal sac, in which peristalsis is lacking. Because of the enormous esophageal widening with severe esophagitis, or masking by food residue, early carcinoma is sometimes overlooked.

Other contrasting findings in cardiospasm and megaesophagus are: the history of cardiospasm is short, i.e., a few years, whereas symptoms of megaesophagus have often been present for decades; inflammation is usually lacking in cardiospasm and always present as stagnation esophagitis, which may also become the site of carcinoma in megaesophagus.

Three characteristic cases are described, showing that the operation for cardiospasm differs from that for idiopathic megaesophagus. For the former, Heller's operation, consisting of extramucosal cardiomyotomy, is the best method and preferable to simple resection, Wangensteen's procedure or even total gastrectomy. For idiopathic megaesophagus, the author designed a "funnelization" procedure. After freeing the lower third a fold was taken in the esophagus to decrease the size of the lumen. Then a collagen membrane was introduced into the esophagus to transform the sac into a funnel. Roentgen control showed that, with swallowing, barium entered the finger-wide cardia and advanced through the cardia into the stomach. The patient felt well, gained weight and was active.

Treatment of Megaesophagus with Heller's Operation: Results of 168 Operations by P. Santy, P. Michaud and R. Latreille[3] demonstrated cure or substantial improvement 18 months to 10 years after in 90%. In 126, symptoms were relieved, and x-rays showed return of esophagus to normal size; 26 had functional relief with some residual radiologic abnormality. Treatment failed in 13 and there were 6 postoperative deaths (3.5%), 4 from infection and 2 from cachexia. Factors affecting surgical results included age of patient, duration of esophageal difficulty, degree of esophageal dilatation and periesophageal inflammation. Physiopathologic mechanisms which, alone or combined, accounted for unsuccessful results were neurosympathetic imbalance, periesophageal cicatricial ring and (most important) gastroesophageal reflux and peptic esophagitis.

Simple esophagitis occurred in 12 cases without hemor-

(3) Lyon chir. 51:513-522, July, 1956.

rhage or anemia, but in 2 it was serious, with a hemorrhagic peptic ulcer resulting in severe anemia Both patients were subjected to esophagojejunal anastomosis, according to Allison's technic, after upper polar gastric resection In the first case, end-to end anastomosis was accomplished by a Y at the curve of the small intestine, with the esophagojejunal anastomosis about 25 cm above the remaining intestine so it was largely protected from irritation by reflux In the second case, esophagojejunal anastomosis was made at the convexity of the small intestine curvature, and despite complementary anastomosis at the base, partial contact with the esophagus caused serious reflux which was finally controlled by section of the afferent curve

Gastroesophageal reflux after Heller's operation apparently has a double mechanism myotomy and suppression of valvular function of the angle of His A final factor (perhaps explaining why hemorrhagic esophagitis is rare) is esophageal stasis If there is no stasis, passage through the cardia is free and reflux is inconsequential But if esophageal stasis causes retention of gastric fluid reflux, the mucosa is corroded by the acid and peptic esophagitis ensues To avoid this complicaton, the authors recommend that the technic be modified to include reconstruction of the angle of His and restoration of esophagodiaphragmatic continuity which is destroyed at the beginning of the operation With these modifications the Heller operation is highly satisfactory It is the most efficacious and simplest treatment of megaesophagus caused by cardiospasm provided the dissection is sufficiently wide, with liberation of the lower esophagus and severing of the splanchnic sympathetic fibers and myotomy of the musculature of the anterior wall of the cardia and stomach to 10 12 cm along the esophagus

Although megaesophagus is a benign disease, it may lead to death Its gravity is due to the danger of cachexia which may follow prolonged dysphagia to the possibility of cancer in the dilated esophagus (the authors observed 2 cases in patients with dysphagia of 15 and 25 years), to respiratory difficulties and to chronic esophageal inflammation

Surgical Management of Achalasia of Esophagus *Periodic esophageal dilatation and medical management benefit* about 85% of patients with achalasia, the rest require sur-

gery Previous methods of correction have been unsatisfactory Herbert R Hawthorne, Alfred S Frobese and Paul Nemir, Jr [4] (Univ of Pennsylvania), found esophagocardiomyotomy to be eminently successful The physiologic basis for the good results is unclear Perhaps they are due to elimination of spasm at the distal end of the esophagus and not to change in esophageal motility

The predominant symptom in achalasia was dysphagia, usually more manifest when solid food was ingested Pain was a major factor in one third of the patients It was usually substernal with occasional reference to the back or around each costal margin and was characterized as a "cramp" or "spasm" or an intense burning sensation No correlation existed between the pain and x-rays or gross findings at operation All the patients showed a dilated esophagus by x-ray A flask-shaped deformity was noted in those who had achalasia for 10 or more years The terminal portion of the esophagus was narrow in all patients and peristalsis was deranged

The authors performed a modified Heller operation or extramucosal esophagocardiomyotomy in 35 patients The cardioesophageal junction was exposed by mobilizing the left lobe of the liver The peritoneal reflection was divided and the thoracic esophagus delivered into the abdomen by traction The anterior esophageal wall was incised longitudinally, beginning 2½ in above the gastroesophageal junction and extending to 1½ in below the junction The longitudinal and circular muscles and the submucosa of the esophageal wall were divided and the mucosa allowed to bulge through the aperture The lumen of the esophagus was not entered In 33 operations, the transabdominal route was satisfactory The transthoracic approach is unnecessary unless carcinoma is suspected Hypertrophy of the circular muscle coat was evident in only 6 patients Biopsies of the muscle layers in 8 patients revealed lack of Auerbach's plexus in only 4

All patients had complete relief from dysphagia immediately after surgery Follow up studies, including x-rays and/or manometric studies of esophageal motility, showed that excellent results persisted in 80% Recurrent dysphagia, appearance of substernal pain or gastrointestinal bleeding occurred in 20% In each patient in whom results were poor,

(4) Ann Surg 144 653 666 October 1956

gastric contents were shown to regurgitate into the esophagus Pyloromyotomy does not protect against regurgitant esophagitis Results of surgery are adversely affected by the preoperative presence of esophagitis or duodenal ulcer One patient died on the 5th postoperative day of a cerebrovascular accident and 3 died 1, 2 and 3 years postoperatively of carcinoma of the midesophagus, pneumonia and pulmonary tuberculosis respectively

Evaluation of Operative Procedures for Achalasia McH S Brewer, W A Barnes and S F Redo[5] (Cornell Univ) reviewed the records of 89 patients with achalasia Most had been treated with belladonna and/or dilatation Thirty underwent operation

Reflux of gastric contents undoubtedly is important in producing esophagitis and its complications, and any disturbance of the normal esophagogastric junction may permit this reflux Despite these considerations, esophagogastrostomy and plastic procedures are still advocated by some for benign lesions at the esophagogastric junction

About three fourths of the patients with achalasia in whom surgery destroyed the normal sphincteric mechanism at the esophagogastric junction developed symptoms of esophagitis, presumably due to reflux of gastric contents The Heller cardiomyotomy gave satisfactory results in 10 of 12 patients, although the follow-up period is short This operation should provide less chance for gastric reflux Procedures at the esophagogastric junction that allowed gastric reflux resulted in ulceration or stricture formation in 11 of 15 patients

Surgical treatment of achalasia by any method allowing gastric contents to reflux into the esophagus should be avoided Dysphagia may be relieved immediately, but the incidence of later ulceration, hemorrhage or stenosis due to the peptic esophagitis is prohibitive The Heller procedure has thus far proved the most satisfactory treatment for uncomplicated achalasia Stenosing lesions at the esophagogastric junction, either primary or resulting from previous operations, may be treated satisfactorily by esophagojejunostomy in Roux-Y fashion, with retention of part or all of the stomach

(5) Ann Surg 144 823 828 November 1956

Surgery of Advanced Idiopathic Dilatations of Esophagus is discussed by Vladislav Rapant, Zdenek Sery and Jaroslav Doubravsky[6] (Palacky Univ., Olomouc, Czechoslovakia), on the basis of 58 operations on 54 patients, without operative mortality. Best results in appropriately selected patients were achieved by extramucous esophagomyotomy through the transthoracic approach. Cardioplasty and esophagogas-

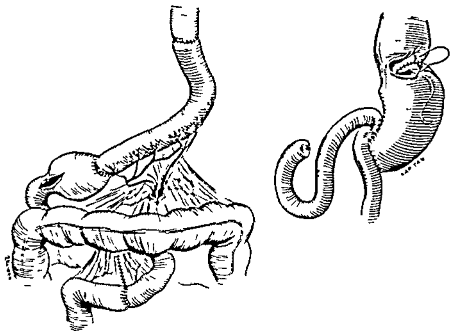


Fig 72 (left) —Resection of distal thoracic esophagus and cranial portion of stomach with interposition of bilaterally excluded jejunal loop and pyloromyotomy
Fig 73 (right) —Grondahl s operation with subtotal resection of distal portions of stomach and gastrojejunostomy
(Courtesy of Rapant, V, *et al* Surgery 41 529 541, April, 1957)

tric anastomosis combined with vagotomy should be abandoned as unphysiologic In advanced cases or those in which previous operation was unsuccessful, the authors used resection of the esophagus and cardia with interposition of the jejunal loop, followed by pyloroplasty (Merendino-Dillard), Wangensteen's resection of the esophagus and cranial segments of the stomach completed with pyloromyotomy (6 patients), if necessary, combined with interposition of the jejunum loop (1 patient) (Fig. 72) or the Grondahl esophagogastric anastomosis with simultaneous subtotal resection of distal segments of the stomach (4 patients) (Fig. 73).

(6) Surgery 41 529 541, April, 1957

The immediate postoperative results of Wangensteen's operation were always favorable, except for complaints due to the small stomach In the postoperative period, averaging 32 months, 2 patients had pylorospasm, which was corrected by subsequent pyloroplasty After the second operation, these patients improved, but final results cannot yet be evaluated The results of Grondahl's esophagogastric anastomosis combined with subtotal resection of distal segments of the stomach were the best so far achieved This operation is considered superior to others because it is less formidable for the patient and surgeon Because of tendency to retraction as broad an anastomosis as possible must be made between the esophagus and stomach

Cardiospasm (Achalasia of Cardia) is a disturbance of esophageal motility characterized by feeble or no peristalsis and failure of the sphincter to open at the cardia Diagnosis may be substantiated by x-ray study and endoscopy, especially by passing a blunt olive tipped bougie over a previously swallowed thread

Relief can be obtained, according to Arthur M Olsen F Henry Ellis Jr, and Brian Creamer[7] (Mayo Clinic and Found), in 60% of patients with a single course of hydrostatic dilation and may ultimately be achieved after 2 or more courses in 80% Hydrostatic dilation is a drastic method of treatment that is not without hazard

Success of treatment cannot be entirely correlated with the size of the esophagus but, in general, results of endoscopic or surgical treatment are less satisfactory when the condition is advanced If dysphagia is not promptly and completely relieved or if it recurs within weeks or months after satisfactory dilation surgery is advisable A properly performed Heller operation probably offers as much to the patient as does hydrostatic dilation, and risk of complication probably is less

Consideration of Certain Benign Lesions of Esophagus Diagnosis of esophagitis cannot be conclusively established without esophagoscopic examination and then often only by biopsy Pyrosis common in complete absence of esophagitis, is not pathognomonic

Little is known about the etiology of esophagitis Char

(7) Am J Surg 93 299 307 February 1957

acteristically, it is often accompanied by a duodenal ulcer. This might suggest an ulcer-forming tendency as an etiologic factor. The reason esophagitis is confined mainly to the lowermost portion might be that the neutralizing effect of saliva is more active in the upper levels of the esophagus. Against the possible role of regurgitation of gastric secretions as an etiologic factor is the observation that regurgitation of barium into the esophagus can be demonstrated in

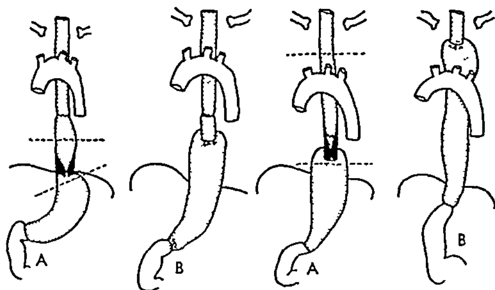


Fig 74 (left) —First operation *A*, stricture in thoracic segment of stomach several inches below cardia Dotted lines delimit portion resected *B*, after resection. Note that short section of thoracic stomach was retained because of failure to recognize true nature of condition and that pyloroplasty was done because of stenosis from previous duodenal ulcerations

Fig 75 (right) —Second operation *A*, location of recurrent stricture in thoracic gastric segment preserved after limited resection 5 years before. Dotted lines show more extensive resection *B*, new anastomosis high in mediastinum Note position of stomach to right of aortic arch Left thoracotomy incision was used for each procedure

(Courtesy of Rapant, V, *et al* Surgery 41 529 541, April, 1957)

practically everyone examined by fluoroscopy, whether a hiatus hernia is present or not, and yet these persons do not have, nor do they necessarily ever develop, esophagitis.

Peptic esophagitis and ulceration are most frequent in patients with a short esophagus and thoracic segment of stomach. Often, the inflammation and ulceration arise chiefly in the tubular segment of the stomach as it lies in the chest. This is not always recognized; many unwittingly leave a segment of stomach by transecting the tubular segment below the cardia (Figs 74 and 75)

According to Richard H. Sweet[8] (Boston), the indicati
for surgery are the same as those for operation on ulcer
the duodenum: (1) hemorrhage from erosion of a blood v

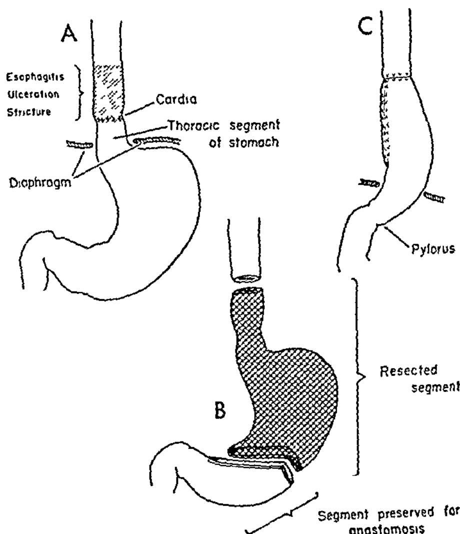


Fig 76—*A* usual location of lesion *B* relative amounts of stomach and eso
gus resected in extensive partial gastrectomy and esophagectomy, sometimes use
reduce acid and pepsin production by remaining stomach *C*, anastomosis and ga
closure (Courtesy of Sweet, R H Surgery 40 447-458, August, 1956)

sel large enough to cause continuous bleeding, (2) penet
tion or perforation, (3) intractable pain not relieved b
proper medical regimen and (4) obstruction from cicatri
contracture not successfully relieved by dilatation

Surgery may be performed in two ways First, advanta

(8) Surgery 40 447-458, August 1956

may be taken of the observation that esophagitis rarely develops in the upper portion of the organ, by resecting a long segment of esophagus and only as much stomach as is needed to perform a high esophagogastric anastomosis To be most effective, the level of division of the esophagus should be above the arch of the aorta (Fig 75) The second approach assumes that recurrence might be prevented by reducing the chances of regurgitation of acid and pepsin from the stomach This can be largely accomplished by extensive resection of the proximal portion of the stomach with as much lower esophagus as needed for complete excision of the diseased segment This removes all of the fundus, a large part of the body and most of the lesser curvature (Fig 76) A tube of stomach along the greater curvature is made by partial closure of the remaining portion and the anastomosis is made end-to end with the esophagus

The etiology of achalasia (cardiospasm) is unknown Although its treatment by bougienage is usually successful, and though there is agreement that this should be used whenever possible, there are cases in which surgery may be required These comprise the small group in which the relief obtained by dilatation is too little or too brief to make it practicable, and the smaller number of patients who refuse to have such treatment Others cannot learn to use a mercury bougie on themselves In properly selected cases, esophagomyotomy reliably produces complete and lasting relief from dysphagia with a minimum of complications and sequelae However it for any reason esophagoplasty or even resection appears the operation of choice, the surgeon should consider the possibility of dysfunction of the pylorus and take measures to overcome this whenever it is found

Consequences of Neglected Hiatal Hernias If epigastric pain, dysphagia, angina-like pain, heartburn, gaseous eructation or any combination of these is present, Brian Blades and Emmett R Hall[9] (George Washington Univ) advocate correction of a hiatus hernia, if careful x-ray examination indicates one is present Two serious complications, hemorrhage and stricture formation, are common in neglected symptomatic hiatal hernias Grave complications are more

(9) Ann Surg 143 822 832 June 1956

common in older patients and increase in frequency with increasing duration of symptoms However, even patients with symptoms of short duration may have bleeding or stenosis At present, the incidental finding of a hiatal hernia without symptoms does not justify surgery

The principles of surgery are reduce the stomach into the abdomen with the cardioesophageal junction at the proper level, destroy the hernia sac, maintain the pinchcock mechanism at the cardioesophageal junction by avoiding injury to the cardia and crura of the diaphragm, and maintain normal esophageal angulation Internists generally are reluctant to recommend surgery for early, mild symptoms Procrastination cannot be condoned in patients with severe disabling symptoms or with hemorrhage, since the risk of surgery is minimal Improvements in anesthesia, availability of blood transfusions and modern surgical advances have made crushing or cutting the phrenic nerve obsolete in treatment of hiatal hernia In older patients, temporary paralysis of the diaphragm may be obtained by injection of procaine into the phrenic nerve at the end of operation

Statistical conclusions are unwarranted in this small series of 66 patients, but only 2 had poor results from operation In both, pain and dysphagia continued Three patients had recurrence of the hiatal hernia, successfully repaired in 2 The frequency of the disease and the high incidence of serious complications are undeniable In an ever aging population, more patients with serious complications will probably be encountered Surgical treatment is recommended for all symptomatic hiatal hernias unless dietary chemical therapy gives prompt lasting relief This is well illustrated by the fact that in the authors' series of 66 cases, 32 (45%) of the patients with symptomatic hiatal hernia had dangerous complications, including bleeding in 22, esophageal stricture in 8, and carcinoma and perforation each in 1

► [The emphasis which these authors place on the fact that symptomatic hiatal hernias represent serious lesions deserves wider recognition Too many physicians assume a rather casual attitude toward this potentially grave disease stemming probably from the observation that hiatal hernia is frequently encountered as an incidental finding during routine x ray examination of the upper gastrointestinal tract This attitude is perhaps reinforced by earlier surgical experience when the risk of operation especially in older persons was relatively high and by the apparent failure to

appreciate the great improvements that have taken place in the surgical management of this disease, which has reduced the mortality to about 1% or less and provided excellent results —Ed]

Repair of Esophageal Hiatal Hernia Utilizing Allison's Principle through Abdominal Approach Before thoracic surgery achieved its present maturity, abdominal repair of hiatal hernia was considered most satisfactory, especially because of complications following thoracotomy In recent years, thoracic repair has been accepted enthusiastically because of the ease of exposure, dissection and repair Allison's method, the simple reapposition of the crura with 3 or 4 interrupted silk sutures, has made the thoracic approach even more acceptable

However, Allison's method can be used with ease from an abdominal incision This has received little attention and is emphasized by Robert P McBurney[1] (Sanders Clinic, Memphis) With the abdominal approach, abdominal exploration can also be done and concurrent disease corrected Further, the prolonged postoperative pain in the chest wall, significant in 10% of thoracotomy patients, is avoided

TECHNIC —An upper midline incision is carried from the xiphoid to the umbilicus After it is carried into the peritoneal cavity, thorough exploration is done If the etiology of the patient's symptoms is in doubt or if other disease is found, other procedures may be performed before the hiatus is repaired

The left triangular ligament of the liver is divided to expose the hiatus and the left lobe folded back The stomach and other herniated viscera are gently reduced and loose peritoneal tissue overlying the esophagogastric junction is dissected away If a hernia sac exists, it is removed A long length of Penrose tubing then is passed beneath the lower esophagus and that organ retracted directly ventrad and slightly to the patient's left The body of the stomach is retracted dorsally and toward the patient s feet This tightens the fibers of the diaphragmatic crus even in large defects Loose tissue overlying the muscle is then trimmed

Repair is with interrupted silk sutures about 1 cm apart placed from below the diaphragm The hiatus is closed until only the little finger can be inserted into it along the esophagus Suture lines need not be reinforced with fascia or other material The muscular edges of the crura usually come together without tension

In the few patients in which this method has been used, all have been relieved of symptoms and have had no recurrences

► [This article deserves emphasis and particularly close attention by sur-

(1) Am. Surgeon 2? 668 671 July 1956

geons who are wedded to the thoracic approach Our own experience which includes both the thoracic and the abdominal approach to this problem has led us to the conviction that the latter is preferable under certain circumstances and confirms the observations reported here by McBurney regarding its advantages For one thing the repair of an uncomplicated hiatal hernia using Allison s principles may be easily performed by the abdominal approach with probably less trauma anesthesia and operative time and consequently less operative risk particularly in older persons For another it permits surgical correction of other abdominal lesions which are frequently associated with the hernia and sometimes of equal or even greater significance This is well illustrated by our own experience Thus in a series of 80 cases of hiatal hernia repaired by the abdominal route there were 83 additional procedures including cholecystectomy in 17 patients subtotal gastrectomy in 6 and aortic aneurysmectomy in 5 The thoracic approach is preferable under some circumstances as in deep chested or obese persons or in complicated hiatal hernia Both approaches thus have their indications and it is desirable to use them accordingly —Ed]

Treatment of Short Esophageal Hernia with Esophagitis by Finney Pyloroplasty was performed on 16 patients by Thomas H Burford and Carl E Lischer[2] (St Louis) None had stenosis After 3 15 months 15 patients were improved 10 showing excellent and 5 good results The one failure was found subsequently to have a paraesophageal hernia without esophageal shortening Repair of the hernia relieved symptoms Postoperative endoscopy of 4 patients showed complete healing of the esophagitis

Esophagitis the commonest disease of the esophagus has many causes It is important carefully to define the type of esophagitis and its cause before considering treatment Esophagitis associated with short esophageal hernia is the commonest type seen by the surgeon and the most recalcitrant to management Esophagitis from reflux associated with ulcer diathesis or gallbladder disease uniformly responds to treatment of the ulcer or removal of the gallbladder Cases associated with paraesophageal hiatus hernia require only repair of the hernia to cure the esophagitis Careful study and case selection are needed for good results

► [As emphasized by these authors it is important to determine the type of esophagitis and its cause before instituting treatment The so called short esophagus for example is most often associated with a sliding hiatal hernia In the majority of these cases the esophagus can be brought down below the hiatus and repair of the hernia provides relief of the esophagitis The authors state that they have done pyloroplasty only on those cases of short esophageal hernia where esophagitis was present but where stenosis

(2) Ann Surg 144 647 652 October 1956

has not developed' Presumably they did not consider repair of the hernia in these cases to be indicated Obviously, proper evaluation of this procedure must await further experience —Ed]

Surgical Considerations in Treatment of Esophageal Hiatal Hernia Theodore T Myre, John W Kirklin, Howard A

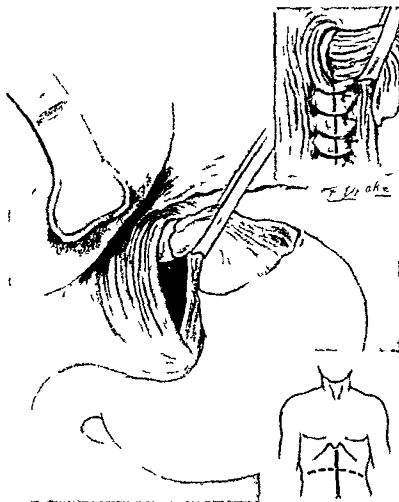


Fig 77.—Exposure of esophageal hiatal hernia ... *inset* usual incisions midline or transverse *Uppe* ... Anatomic repair is similar to that obtained when ... phragm (Courtesy Myre T T *et al* J A M A

Andersen and O Theron Clagett[3] (Mayo Clinic and Found) operated on 113 patients to correct their esophageal hiatal hernia Before operation, 78% experienced symptoms attributable to the hiatal hernia The commonest complaint was substernal burning distress, while dysphagia or regurgita

(3) J A M A 164 147 150 May 11 1957

tion was noted by about a third of the patients, gastrointestinal bleeding was present in 19% The hernia proved to be of the sliding type in 97 patients and of the paraesophageal (rolling) type in 16

Surgical repair can be done either from a thoracic or an abdominal approach The latter (Fig 77), used in 57% of the patients, has the advantage that it may lead to recognition and correction of intra-abdominal disease

Postoperative symptomatic relief was experienced by more than 90% One death occurred after operation, resulting from pseudomembranous ileocolitis The recurrence rate relatively early in the postoperative course was 10%, and may be higher after longer follow-up This recurrence rate would discourage attempts to repair small, asymptomatic esophageal hiatal hernias

Physiologic Operation for Ulceration and Stricture of Terminal Esophagus. Because of the unsatisfactory results of present surgery for patients with ulceration and stricture of the terminal esophagus, F Henry Ellis, Jr [4] developed the following procedure

TECHNIC —The patient is placed in a right lateral decubitus position on a side-tilting table, with the shoulders at right angles to the table and the hips tilted posteriorly to an angle of about 45 degrees with the table With the patient under intratracheal anesthesia, a left thoracoabdominal incision is made, starting from a point just to the right of the midline and slightly above the umbilicus and extending across the costal margin to the 6th or 7th intercostal space The thoracic portion of the incision extends posteriorly to the paraspinal muscles Choice of the intercostal space is determined by the level of the esophageal lesion

The diaphragm is opened in the direction of the incision, and the incision is carried across the esophageal hiatus The lung is retracted superiorly, and the mediastinal pleura over the esophagus is opened (Fig 78) It is essential that enough esophagus be freed to reach relatively normal tissue The cardia is then mobilized from its diaphragmatic and posterior peritoneal attachments Clamps are appropriately placed, and the diseased area is excised (Fig 78, *a*) Bilateral vagotomy is done The cut end of the stomach is closed Severing some of the short gastric vessels permits elevation of the fundus to a relatively high level in the thorax without dividing the left gastric arteries The cut and sutured end of the stomach then lies in a right medial and inferior position in respect to the anastomosis (Fig 78 *b*)

An opening is then made in the stomach Healthy esophagus is

(4) Proc Staff Meet Clinic 31 615 619, Nov 14 1956

anastomosed to the opening, and a nasal tube is passed through the anastomosis for a short distance The distal third of the stomach and a small portion of the duodenum are then resected (Fig 78, *a*), and an end to end esophagoduodenostomy of the Schoemaker-Billroth I type is done (*b*) The lesser curvature portion of the stomach is closed The stomach is anastomosed to the duodenum in three layers

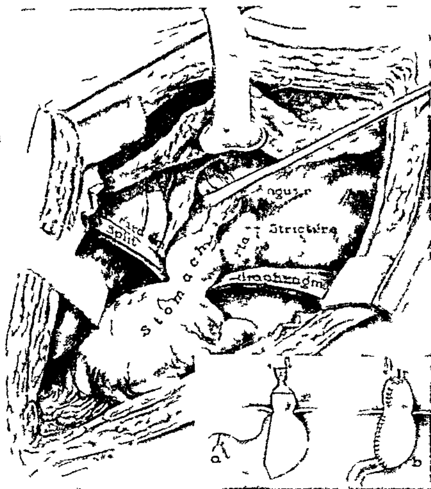


Fig 78 —Exposure afforded by thoracoabdominal incision showing short esophagus diaphragmatic hernia with esophageal stricture *Inset* shaded areas to be resected (*a*) and completed operation (*b*) (Courtesy of Ellis F H Jr Proc Staff Meet Mayo Clin 31 615 619 Nov 14 1956)

The diaphragm and hiatus are closed No anchoring stitches are necessary After closure of the thoracic incision, an intercostal tube is placed in the thorax for postoperative drainage Finally, the abdominal portion of the incision is closed

This operation was performed on 18 patients, with 1 hospital death Though sufficient time has not elapsed for final evaluation early results warrant its further clinical trial

Rupture of Esophagus is discussed by J Maxwell Chamberlain and W Grimes Byerly[5] (Roosevelt Hosp, New York) and four cases reported The lesion carries a high mortality and morbidity unless diagnosis and therapy are prompt It is not the rupture per se that threatens the patient but the introduction of anaerobic infection into virgin fascial planes Causes are external violence, infections and neoplasms, aortic aneurysms, penetrating missiles, foreign bodies, *instrumentation, increased intra-abdominal pressure*, tumors of the esophagus and esophagitis The most common cause of injury is endoscopy or bougienage Spontaneous and postemetic ruptures occur at the lower end of the esophagus, following violent retching or vomiting

Early symptoms may be almost negligible, particularly in ruptures which are small or which develop slowly If the rupture is cervical, pain is located in the neck, "throat" or upper anterior thorax It may be severe and aggravated by motion, so that the patient holds the neck rigid Dysphagia and dysphonia may be prominent If the lower esophagus is ruptured, as in the postemetic type, pain is the first symptom It is usually quite severe, aggravated by motion and substernal or epigastric It may radiate straight through to the back and may be accompanied by pleurisy The patient may describe something bursting and moving in the chest

In lower esophageal rupture with rapid mediastinal and pleural soiling, the patient may quickly appear severely ill, dyspneic, tachypneic and cyanotic Temperature rapidly rises Subcutaneous emphysema is the earliest sign first in the suprasternal notch and spreading into the neck and over the thorax With pleural penetration, signs of effusion or hydropneumothorax may be present Upper abdominal muscles *may be spastic and ileus may be present* Laboratory examination may show leukocytosis, and later changes in hematocrit may reflect dehydration X-rays may show subcutaneous emphysema and displacement of the trachea, and injection of radiopaque substances may demonstrate the site of rupture Thoracentesis, with recovery of air or fluid, or especially food particles, hydrochloric acid or blood, is diagnostically helpful Prompt diagnosis is aided by a high index

(5) Am J Surg 93 271 281, February, 1957

of suspicion Any patient who has had instrumentation or probable ingestion of a foreign body or who has been vomiting and develops pain in the neck or thorax with subcutaneous emphysema should be considered to have an esophageal rupture until proved otherwise

Prognosis is related to the site, etiology, size and time elapsed since rupture If the rupture is cervical, small and recognized early, prognosis is good If large, in the thoracic mediastinum and recognized late, prognosis is grave In the acute stage, nearly all deaths are due to shock secondary to hypoxia from tension pneumothorax and overwhelming sepsis Later deaths are due to chronic sepsis, fistula formation and malnutrition

Small cervical esophageal ruptures in the early stages are best treated conservatively with broad-spectrum antibiotics, nothing by mouth and intravenous fluids Oral hygiene is important and broad-spectrum antibiotic lozenges to dissolve in the mouth may help prevent further bacterial contamination Large ruptures may be treated by primary suture In late stages, the most effective therapy is classic cervical mediastinotomy, draining the retrovisceral space of the neck and the superior posterior mediastinum Early large and small ruptures of the thoracic esophagus are best treated with prompt open operation For older ruptures, drainage may be necessary If therapy has been delayed, operation may have to be done in stages

Etiology and Histogenesis of Carcinoma of Esophagus were studied by Paul E Steiner[6] (Univ of Chicago) in 116 cases at autopsy Controls consisted of 116 autopsy cases each of carcinoma of the stomach, carcinoma of the lung, malignant lymphatic disease and no cancer Cancer of the esophagus, as contrasted with the control groups, was associated with a higher incidence of a history of heavy alcohol consumption, cirrhosis of the liver, second independent primary malignant tumors in the upper alimentary tract, polyps of the large intestine and, probably, heavy tobacco usage Other benign tumors were not unusually frequent Age and sex distribution in this and in other series of cases and ethnic, geographic, occupational, site and previous usage factors

(6) Cancer 9 436-452 May June 1956

seem to indicate, with the statistical associations already mentioned, that etiologic factors are numerous and environmental—chiefly chemical, physical and nutritional damage. Injuries that eventuate in cancer tend to be greatest at points of anatomic narrowing, natural or abnormal. Cell hardship that leads to cancer may be inflicted from either side of the epithelial lining and, in some cases, may be consequent to the cell malnutrition that follows subepithelial fibrosis.

Discovery of an excessive association with polyps of the colon may indicate that an inherently high susceptibility of the alimentary tract to neoplastic transformation may be important in determining whether injurious agents are effective in cancer induction in this tract. High levels of associated cancers in the upper alimentary tract suggest that these precipitating factors are exogenous. The associated heightened frequencies of histories of excessive alcohol intake and of cirrhosis of the liver strongly suggest that in some instances this exogenous agent may be alcohol. The study of 9 small, silent, incidentally discovered esophageal cancers and of control material indicated that these tumors usually arose from epithelium that tended to be atrophic and to be based on a fibrotic lamina propria. Widespread areas of epithelial hyperactivity with cell polymorphism are exceptional. Statistically, clinically silent cancer of the esophagus is much less frequent as an incidental autopsy finding than is prostatic carcinoma. This fact, with the morphologic evidence, indicates that a prolonged in situ stage is not the rule in esophageal cancer.

Carcinoma of Esophagus: Review of 381 Cases Admitted to Toronto General Hospital 1937-53 Inclusive is presented by Robert A. Mustard and Olive Ibberson.[7] The study group was made up of 242 men (63.5%) and 139 women (36.5%). Average age was 62.9 years. The maximum concentration of the tumors/unit of area was in the hypopharynx

Of the whole series, only 8 patients (3%) survived 5 years; 5 had hypopharynx lesions, 2 adenocarcinomas of the abdominal esophagus and 1 a squamous cell cancer of the thoracic esophagus Of 87 "untreated" patients, only 2 lived 2 years; none survived 2½ years.

(7) Ann Surg 144 927-940, December, 1956

Of 100 patients treated with palliative "ostomy" (plus radiotherapy in 26), only 6 survived 1 year and 1 was alive at 4 years. The value of gastrostomy for symptomatic relief or prolongation of survival is questioned. In patients considered able to tolerate the operation, the authors prefer a substernal bypass procedure, using either jejunum or colon to restore the ability to swallow.

Of 125 patients treated with high voltage irradiation, only 1 survived 5 years. This patient had a squamous carcinoma of the posterior wall of the hypopharynx. Experience with patients treated since 1953 by the cobalt "bomb" has, however, been somewhat more favorable. Most patients so managed receive at least temporary palliation, while in a few the primary tumor may be obliterated.

Only 133 patients (34.9%) were subjected to tumor surgery. Resection was accomplished in 100 (75.2%), hospital deaths after operation totaled 48 (36.1%). The 5-year survival rate for patients who had complete excision and reconstruction of esophagus was 19.4%.

When possible, palliative surgical management should consist of a bypass procedure to restore swallowing; gastrostomy should be used only when all other measures have failed or are contraindicated.

Treatment of Carcinoma of Esophagus is summarized by D. W. Smithers[8] (Royal Marsden Hosp., London), who reviewed the records of 314 patients. Of 65 untreated patients 62 died within 6 months and none survived 2 years. Of 20 patients treated by resection, 12 died within 6 months and 1 survived more than 2 years. Radiation treatment was given to 229 patients, 120 died within 6 months and 20 lived for more than 2 years.

In reviewing all 5 year survivors after any treatment for cancer of the esophagus, as found in the world literature, the author observed that surgery is successful predominantly in the lower third of the esophagus, where access and reconstruction are easiet, and radiotherapy in the upper esophagus where involvement of inaccessible lymph nodes below the diaphragm is least common. Although little success has been obtained with tumors in the middle of the esophagus

(8) Ann. Roy. Coll. Surgeons England 20: 36-49, January, 1957.

and radiotherapy continues to result in rather more survivors than surgery in this group, other advantages of radiotherapy weigh heavily in its favor as the method of choice for these patients With minimum discomfort, with a hospital stay of a few weeks (usually helpful for a starving patient who can thus be properly fed and cared for) and with virtually no treatment mortality, most of these patients treated by modern methods swallow well again until their death Their total survival time in comfort greatly exceeds that currently secured for the surgical group

There seems to be a place for combined surgical and radiation treatment in some patients, either by preoperative irradiation or by use of radioactive gold grain implants

Radical Operations for Cancer of Middle Third of Esophagus B A Petrov[9] (Sklifosovsky Inst, Moscow) reports on 648 patients who were treated for squamous cell cancer of the midthoracic esophagus Only one third underwent surgery, and nearly half of them had exploration only Radical operation was performed in only 123 patients (19%)

Petrov prefers the approach through a right sided thoracotomy in the 7th or 6th intercostal space with cartilage intersection of two ribs and without preliminary pneumothorax After mobilization of the esophagus, its lower cut end is ligated and oversewn In most patients the esophagus is put out from the neck to the left, which is technically easier than from the right Gastrostomy is performed mostly after 2 3 days

In 32 resections of the thoracic esophagus simultaneous esophagogastric anastomosis was done In 16, the anastomosis was performed near the aortic arch, in the other 16 below the arch

Twelve patients were operated on by the "tunnel method for cancer of the thoracic esophagus, 4 survived An artificial subcutaneous esophagus was created in 3 The immediate mortality rate was lowest with the Torek method In 123 radical operations 61 patients survived Half of these died within a year and only 4 patients survived 4½ 5 years

► [While this is an extensive experience results of therapy are unusually poor with an operative mortality for resection (50%) that is exceedingly high Moreover most surgeons have abandoned the Torek method since

(9) Acta chir scand nav 112 145 151 1957

one of the important objectives of resectional therapy is relief of obstruction and restoration of swallowing —Ed]

Anterior Approach to Carcinoma of Superior Mediastinal and Cervical Segments of Esophagus is described by William R Waddell and J Gordon Scannell[1] (Harvard Med School)

TECHNIC —With the patient in the dorsal decubitus position, the cervical esophagus is exposed initially with the skin incised as for thyroidectomy and the left end extended up anterior to the sternocleidomastoid muscle, almost to the mastoid process Dissection is

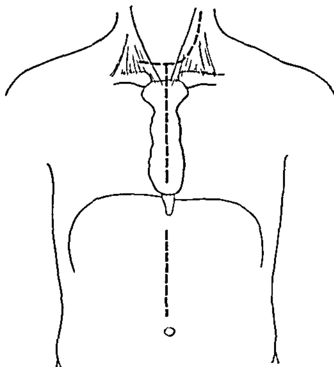


Fig 79 —Skin incisions used for cervical mediastinal and abdominal approach to esophagus (Courtesy of Waddell W R and Scannell J G J Thoracic Surg 33 663 669 May 1957)

then carried in front of the muscle, over the carotid sheath and behind the thyroid to e pharynx Lesions in this region can with regional lymph nodes If the le r the sternum is incised (Fig 79) and the sternum split with a Lebsche knife Separation of the two halves is accomplished with a small rib spreader This exposes the upper mediastinum The pleura is pushed back and the left innominate vein interrupted Further dissection posteriorly along the left side of the trachea exposes the esophagus down to the level of the aortic arch The left recurrent laryngeal nerve is routinely sacrificed Mobilization of the supra aortic portion of the esophagus is

(1) J Thoracic Surg 33 663 669 May 1957

easily carried out under direct vision and separation of the esophagus or tumors from the trachea may be done safely If necessary, portions of the membranous trachea can be excised Esophageal arteries arising from the aortic arch and from bronchial arteries can be secured and ligated under direct vision Access to the upper midesophagus can be facilitated by gently lifting the aortic arch forward and

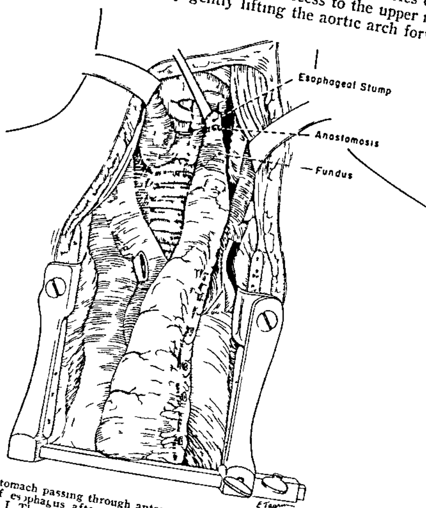


Fig 80 —Stomach passing through anterior mediastinum and anastomosed to uppermost portion of esophagus after esophagectomy (Courtesy of Waddell W R and Scannell J G J Thoracic Surg 33 663 669 May 1957)

to the left Thus the normal portion of the esophagus can be freed down to the carina and beyond by finger dissection

When resectability of the lesion is established, a second team begins mobilization of the entire stomach through a midline upper abdominal incision so as to preserve the right gastric and right gastroepiploic vessels The short gastric and left gastroepiploic vessels are divided The left gastric artery is secured near its origin The surgeon working from the abdominal approach mobilizes the lower esophagus and draws it down Through the hiatus, the lower esophageal vessels

can be pulled down with a finger and the proximal portions clamped and ligated Thus the dissection from above meets that from below Entire esophagus is thus freed and after severance from the stomach delivered into the superior mediastinum The mobilized stomach is brought through an opening in the anterior portion of the diaphragm into the anterior mediastinum (Fig 80) the stomach will reach the pharynx by this route without undue tension A 3 layer anastomosis between the stomach and pharynx, or esophageal stump is made with fine interrupted silk sutures The abdominal wound is closed in layers with through and through stay sutures and the sternum wired with heavy steel A tracheostomy is established before withdrawal of the endotracheal tube this can be placed to the right of the midline so that it does not communicate with the area of mediastinal dissection After transplantation of the stomach into the thorax a Levin tube should be left in place and aspirated continuously until the patient can be upright while taking fluids and until satisfactory emptying of the stomach has been demonstrated

The advantages of this surgical approach are (1) that it allows easy and direct exposure of the esophagus from the aortic arch to the pharynx (2) neither pleural cavity needs to be entered and (3) gross extensions of tumor to lymph nodes in cervical and upper mediastinal areas can be removed readily with the primary tumor

Its principal disadvantage is that if the stomach is used for restoration of continuity the entire distal esophagus must be removed which involves more or less blind dissection from the level of the carina down to the diaphragm Significant bleeding from esophageal arteries stripped from the esophageal wall (not encountered in this series) is an inherent danger that might require radical extension of the approach A logical modification might be to transect the esophagus beneath the tumor turn in the distal cut end resect the tumor and adjacent lymph nodes and restore continuity by transplantation of the colon or jejunum through the anterior mediastinum In most patients the colon is mobilized more readily than the stomach

THE STOMACH AND DUODENUM

Giant Hypertrophy of Gastric Mucosa (Hypertrophic Gastritis) is discussed by J E Strode[2] (Straub Clinic Honolulu) In the giant type of hypertrophy of the gastric mucosa the stomach usually is larger than normal and not infrequently is involved in surrounding adhesions Adjacent lymph nodes usually are enlarged The stomach wall feels thickened Tortuous mucosal folds vary from 1 to several cm in both width and height they are freely movable Hypertrophy more frequently found in males may affect the entire gastric mucosa or only a small area

Symptoms are not characteristic Most patients complain of epigastric distress and fulness Severe epigastric pain and tenderness vomiting and passing of blood occasionally occur Duration of symptoms varies from a few weeks or months to many years

Differentiation of hypertrophic gastritis from other pathologic lesions of the stomach particularly malignancy may at times be impossible without exploration examination and biopsy When such patients are subjected to operation it probably is inadvisable to do more than establish diagnosis unless the patient s symptoms are severe Partial gastrectomy even total gastrectomy may rarely be indicated however

The role of hypertrophic gastritis as a lesion predisposing to gastric malignancy has not been established

Uropepsin Excretion Relation to Duodenal Ulcer Disease in Diagnosis and Therapy Uropepsin is the inactive proenzyme pepsinogen found in the urine of normal humans There is a quantitative ratio of 99 1 between the secretion of the chief cell into the gastric lumen and into the blood Thus it accurately reflects the peptic activity of the stomach at a given time Patients with duodenal ulcer consistently excrete at least twice as much uropepsin as normal control subjects Lloyd M Nyhus[3] (Univ of Glasgow) studied the uro

(2) Surgery 41 236 247 February 195
(3) Ib d pp 406 41 March 1957

pepsin excretion of 72 patients with previous simple gastrojejunostomy for duodenal ulcer The patients were divided into three classes according to their clinical response to therapy Class I comprised patients who were asymptomatic after surgery Patients in class II had upper gastrointestinal symptoms postoperatively, whereas those in class III had proved recurrent ulceration Most patients were men Recurrent ulceration was not found in any women

The mean uropepsin excretion/24 hours for all patients in this study was 472 units, essentially the same as for patients with duodenal ulcer who did not undergo operation There was no significant difference in uropepsin excretion between classes I and II, only between classes I or II and class III This difference in excretion can be used as a reliable indicator of recurrent ulceration in patients with symptoms after gastrojejunostomy The similar uropepsin excretions before and after surgery reflect both chronic and acute stress

Quantitative Studies on Effect of Gastric Resection on Secretion of Gastric Juices Current surgical treatment of duodenal ulcer emphasizes subtotal gastric resection The aim of this operation is to reduce the acid secreting capacity of the stomach Experience has shown that after subtotal resection most duodenal ulcers heal A quantitative relationship, however, between the amount of stomach removed and the secretion of acid gastric juice has never been shown

Herzl Ragins, S O Evans Jr, L R Dragstedt II, S P Rigler and Lester R Dragstedt[4] (Univ of Chicago) studied the secretory characteristics of total innervated fundic pouches of the dog s stomach quantitatively by three methods 24-hour collections, response to a standard insulin test, and response to a standard histamine test The pouches were resected in three stages, with the nerve supply kept intact, and were studied after each operation

An almost direct relationship was found between amount of fundic mucosa present and 24-hour daily gastric secretions The gastric secretory response to insulin and histamine fell much more rapidly Free acid concentration did not fall significantly until the final stages of resection which sug-

(4) A M A Arch Surg 74 266 272 February 1957

gests that the cardiac end of the stomach is poor in acid secreting parietal cells

Stress and Duodenal Ulcer and their relation was studied by Lester R Dragstedt, Herzl Ragins, Lester R Dragstedt, II, and Shirl O Evans, Jr[5] (Univ of Chicago) in animal experiments and *clinical investigations* These studies confirmed the belief that physical trauma, including burns, can induce acute ulceration in the stomach or duodenum or cause exacerbation in previously existing chronic ulcers Surgical operations in the cranial cavity or elsewhere appear to act similarly These effects appear in only a few subjected to these injuries Such traumas also cause immediate and marked increase in output of corticotropin from the anterior pituitary and of epinephrine and corticoid hormones from the adrenals Prolonged administration of corticotropin or cortisone exacerbates existing ulcers or causes new ones in occasional subjects, but not in all Sustained hypersecretion of gastric juice of either humoral or nervous origin produces progressive chronic gastric and duodenal ulcers in dogs Usually 2 6 weeks are required, and output of gastric juice must be at least 2 3 times normal

That physical stress produces or exacerbates ulcers through gastric hypersecretion produced by liberation of cortisone is however, not supported by this study In quantitative studies in Heidenhain pouch dogs, severe burns caused diminution rather than stimulation of gastric secretion Transfusion of blood from severely burned dogs also depressed gastric secretion in recipient animals These findings speak against the concept that histamine or a similarly acting gastric stimulant is released in significant amounts in the blood stream Neither corticotropin nor cortisone stimulated secretion of gastric juice from accessory stomach pouches in dogs and pigs comparably to histamine or insulin hypoglycemia, or to the degree produced by food taking These findings suggest a secondary effect on gastric secretion as might be produced by alterations in electrolyte composition of the body, or to changes in appetite, food taking, or other factors

Continuous secretion of gastric juice is regularly found in

(5) Ann Surg 144 450 463 September 1956

the empty stomach of a normal man The mechanism of this continuous secretion is thought to be largely of nervous origin and mediated by the vagus nerves The fasting hypersecretion of gastric juice in duodenal ulcer patients is usually exaggerated the night before operation, possibly because of apprehension It was also found that fasting nocturnal gastric secretion in duodenal ulcer patients is minimal during the first 5 days after vagotomy and gastroenterostomy, indicating that surgical trauma does not stimulate gastric secretion in the vagotomized stomach, and, further, that hypersecretion of gastric juice in duodenal ulcer patients is of nervous rather than hormonal origin

► [Few men have contributed more to our knowledge of gastrointestinal
duodenal ulcer than Dr Lester
al and experimental studies re
ns field of investigation reflect
his thoughtful and fruitful approach to this problem —Ed]

Inhibitory Action of Locally Applied Antihistamines on Canine Acid Gastric Secretion Induced by Histamine A W Kay and A P M Forrest[6] (Western Infirm , Glasgow) studied the secretory response of separated canine stomach pouches to 0 05 mg histamine base/kg body weight injected subcutaneously after the direct application of 1, 2, 4 and 6 mg /ml promethazine hydrochloride and 2 mg /ml mepyramine maleate to the mucosa of the pouch Both substances inhibited the acid secretion induced by histamine, promethazine was the more potent This inhibition is a true antagonism to histamine and not a local anesthetic or atropine like action The failure of parenterally administered antihistamines to antagonize histamine at the parietal cell remains unexplained

Physiologic Effects of Various Types of Gastrectomy on Gastric Acid Production with Special Reference to Function of Denervated Gastric Antrum Alan P Thal, John F Perry, Jr , and Owen H Wangensteen[7] (Univ of Minnesota) studied the effect of tubular and segmental gastrectomy on Heidenhain pouch secretion Tubular gastrectomy regularly caused marked hypersecretion of acid gastric juice from the pouch This effect did not follow the segmental operation In seeking explanation for such opposite results in procedures

(6) Brit J Surg 43 527 524 March 1956
(7) Surgery 41 576 588 April 1957

superficially similar, the authors found that if the vagus innervation of the antrum were preserved during segmental gastrectomy, hypersecretion resulted Conversely, division of the antral vagus fibers after tubular gastrectomy temporarily decreased gastric secretion These findings suggest that vagus denervation of the gastric antrum induces a lessened responsiveness to chemical and mechanical stimuli In operations in which the antrum is retained, careful study of its behavior under such altered circumstances should be made However, if the partial cell mass has been adequately resected, the likelihood of ulcer recurrence is reduced to a reasonable level

► [These well designed experiments should provide a better understanding of the function of the gastric antrum and help to clarify some of the problems associated with antrum preserving operations for peptic ulcer —Ed]

Massive Hemorrhage from Peptic Ulcer Following Operation or Trauma· Report of Seven Cases with Six Recoveries Irwin Goldfarb and Harry C Saltzstein[8] (Sinai Hosp, Detroit) report on 7 patients in whom severe peptic ulcer followed operation or trauma In 1 patient, recovery followed daily transfusions of 1,000 1,500 cc , in another, recovery followed 20 pt blood given during 4 days Persistence of symptoms necessitated elective gastrectomy In 5 patients, emergency gastrectomy was required, 4 recovered, 1 died

Tissue hypoxia is rather frequent after major surgery or the stress of trauma and infection Experimental evidence shows that in burns hemoconcentration may predispose to gastrointestinal ulcer Some patients in this series—also several similar ones cited in the literature who died—either had stormy convalescences from various infective processes, or the operation was prolonged or the patient bled freely, or he was in shock of varying intensity either at time of operation or later This is exclusive of and before massive hemorrhage from the ulcer Tissue hypoxia may come on insidiously Preoperative blood loss or deficiency may not be completely replaced Long careful dissection may cause more blood loss than a quicker procedure and in treatment of postoperative complications the need for more blood may similarly not be recognized

(8) Gastroenterology 31 525 529 November 1956

Acute Hemorrhage from Peptic Ulcer: Follow-up Study of 310 Patients was done by Austin B Chinn, Arthur S Littell, George F Badger and Argyle J. Beams[9] (Western Reserve Univ) on those who had one or more episodes of acute bleeding from peptic ulcers during 1936-48 There was a 94 2% follow-up to July 1951 Of the 173 patients whose hemorrhages were due to duodenal ulcer and who had had no hemorrhages or operations before, those who survived the 1st hemorrhage and were continued under medical management had a 31% chance of having a 2d hemorrhage within 5 years of the 1st Those who survived a 2d hemorrhage and were continued under medical management had a 64% chance of having a 3d hemorrhage within 5 years of the 2d Predictions were that about 3% of those who survived the 1st hemorrhage would die of a subsequent hemorrhage and 13% would die of other causes About 45% of those who survived the 1st hemorrhage would have either a hemorrhage or surgery within 5 years

The age of the patient did not influence the chance of having a 2d hemorrhage from duodenal ulcer, but the mortality from the 1st hemorrhage and probably from subsequent hemorrhages increased with age The patient who had had multiple acute hemorrhages and was over age 50 offered the least favorable prognosis for continued successful medical management

The survival after a massive hemorrhage from duodenal ulcer did not appear to alter the risk of later death from causes other than ulcer The mortality after the 1st hemorrhage from gastric ulcer was higher in patients over 50 than in younger patients

Experiences with Treatment of Acutely Massively Bleeding Peptic Ulcer by Blood Replacement and Gastric Resection in 193 patients is reported by John D Stewart, James H Cosgriff and James G Gray[1] (Univ of Buffalo) Indications were gross bleeding into the upper gastrointestinal tract within a week, a measured total red cell mass less than 60% of the expected normal and reasonably good clinical evidence for the diagnosis Patients not meeting these criteria

(9) New England J Med 255 973 978 Nov 22 1956
(1) Surg Gynec & Obst 103 409-415 October 1956

were treated supportively, unless bleeding continued or recurred and the criteria were met

The average age of patients was 57 2 years, 18% were over age 70 Half the patients who recovered and three fourths of those who died had serious associated diseases Cardiovascular disease was frequent in patients over age 50 The commonest postoperative complications in patients who recovered were wound infection and dehiscence, pulmonary atelectasis and pneumonia, commonest in those dying were cardiac complications Dehiscence of the duodenal stump stomal arrest, transfusion reaction and postoperative hemorrhage were rare The average amount of blood given before and during operation was 2,600 cc Orthodox subtotal gastric resection with removal of three fourths of the stomach and antecolic Hofmeister anastomosis was usually performed Postoperative mortality was 3% under age 50 and almost 18% over 50

Management of massively bleeding peptic ulcer by immediate blood replacement and gastric resection is based on the following concepts Danger is increased by age and serious associated disease which lower the patient's physiologic reserve Whether gross bleeding from peptic ulcer in a given patient has ceased or whether it will recur are open questions, explosive secondary hemorrhage may be rapidly fatal even under hospital treatment Bleeding from peptic ulcer can be arrested surgically by an operation, which is also good treatment for the ulcer diathesis Surgical operation and resuscitation from hemorrhage can be done concurrently with proper use of blood transfusion, good anesthesia and surgical skill

► [Dr Stewart and his associates have devoted considerable interest and effort to this problem Their thoughtful clinical investigations have provided sound recommendations that deserve wide adoption —Ed]

Upper Gastrointestinal Hemorrhage of Obscure Origin Peptic ulcer in which the site is not determined causes most bleeding Other lesions causing hemorrhage may be esophageal or gastric varices, diffuse gastritis with superficial erosion, shallow, solitary acute gastric or duodenal ulcers, duodenitis, benign tumors of the stomach, hiatus hernia and, rarely, biliary tract disease James A Kirtley, Jr, Douglas H Riddell and E Ide Smith[2] (Vanderbilt Univ) report on 26

(2) Ann Surg 145 789 795 May 1957

patients with severe hematemesis and melena who underwent operation for control of blood loss

Indications for surgery were (1) continual bleeding for 48 hours despite adequate medical management, (2) hematocrit which could not be maintained with 500 ml whole blood every 8 hours, (3) an exsanguinating hemorrhage for which excessive amounts of blood were needed to maintain blood pressure, (4) massive bleeding in a patient over age 50, (5) bleeding which stopped but recurred while the patient was still under a rigid medical regimen and/or (6) multiple recurrent hemorrhages Each patient met at least one of these requirements There were 17 men and 9 women Average age was 46 Eleven had had previous epigastric symptoms

In 12 patients, the initial operation was exploratory laparotomy Of these, 8 had also gastrotomy, duodenotomy or both, without demonstration of the bleeding site, 4 had laparotomy only Of the 12 patients 7 bled subsequently and required "empiric" gastric resection later A total of 21 patients had "empiric' gastric resection of 30 100% Of the 12 patients who had exploratory laparotomy initially with or without gastrotomy, 8 either required subsequent resection for bleeding or died (67% failures) Of the 21 patients who had gastric resection as a primary or secondary procedure, 2 had recurrent bleeding and 6 died postoperatively (38% failures) None of the 6 who died postoperatively died of hemorrhage Although the number is too small for statistical analysis, the difference between 67 and 38% failures may be important and "empiric" gastric resection appears useful in treatment of upper gastrointestinal hemorrhage of obscure origin

The patient should be managed by both an internist and surgeon Evaluation should be early during hospitalization Injudicious delay with constant or recurrent blood loss lowers the patient's ability to withstand the inevitable operation The site of bleeding must be established as being in the upper gastrointestinal tract Early x ray examination with barium may help exclude varices or duodenal ulcer even in the presence of blood Esophagosopy may be of great value When the abdomen is opened, the stomach, duodenum and jejunum should be carefully examined A liberal gastrotomy and duodenotomy should be done, with careful attention to

the 2d and 3d portions of the duodenum Irrigation of the folds with saline may aid visualization of small lesions Application of a sponge or suction is inadvisable If all efforts to locate the bleeding site fail, "empiric" 75% gastric resection seems to offer best assurance against further bleeding

Acute Free Perforation of Gastric and Duodenal Ulcers Experiences from Kirurgiska Hospital, Helsingfors, in 1946-1955 Harry E Blomquist and Gustaf Fock[3] studied 245 patients, aged 16 90, who were treated for acute free perforations of gastric and duodenal ulcers Most patients were engaged in heavy work Only 5 3% were women Most perforations occurred during the season from May to December, between 4 and 5 p m The usual operation performed was simple suture sometimes covered with a flap of omentum The mortality rate for the entire group was 11 4% Operative mortality in 239 patients was 10 5% It was lower among the younger patients For patients operated on within 6 hours the mortality rate was 2 3% and for all those operated on within 12 hours it was 4%

Decreasing Mortality from Perforated Peptic Ulcer Peter J Guthorn[4] (Asbury Park, N J) reviewed case histories of 165 patients with perforated peptic ulcer treated in a community hospital over 20 years There has been little change in the clinical picture except for increased incidence among women

The acute symptoms start with sudden rupture of the base of a gastric or duodenal ulcer and escape of highly irritating contents into the peritoneal cavity Immediate and spreading chemical peritonitis eventually involves most or all of the peritoneal surfaces Occasionally perforation is not free but is contained to some extent by previous adherence of omentum, parietes or other viscera Inflammatory response to peritoneal irritation results in secretion of large amounts of fluids and electrolytes into the peritoneal cavity at the expense of circulating body fluids At first this is essentially sterile, but later there is bacterial growth Gastric hyperacidity is a protection against the entrance of pathogenic organisms Conversely, perforations occurring in hyperacidity or anacidity are likely to result in more organisms of

(3) Acta chir scand nav 112 259 ? 0 1957
(4) J M Soc New Jersey 53 35? 358 July 1956

greater pathogenicity This probably explains the greater mortality in gastric as compared with duodenal perforation

Associated bleeding and perforation was found to increase mortality and morbidity As age progresses, inflammatory response to injury is less prompt and sustained Sex plays no apparent part except that the female is less often suspected of perforation and most frequently suspected of disease originating in the pelvic organs Incidence of missed diagnosis seems to be about 1%, usually in atypical or bizarre cases

If escape of irritating gastric or duodenal fluid is contained by operative closure before bacterial growth, recovery can be expected with a minimum of complications Likewise, gastric suction will remove most of the gastric secretion before escape into the peritoneal cavity and allow sealing of the defect Should escape of fluid continue, generalized peritonitis causes death by sepsis, dehydration and electrolyte imbalance If chemical peritonitis persists without bacterial growth, a plastic peritonitis will develop with multiple small intestine obstructions This explains cases of long survival and gradual death by inanition Increasing age, long duration and gastric as opposed to duodenal perforation have an adverse effect

Surgery after 24 hours appears contraindicated The perforation is usually sealed by this time and peritoneum and omentum are better able to accomplish removal of peritoneal contaminants than is transabdominal drainage

General use of parenteral fluids, transfusion and nasogastric suction with sulfonamide and antibiotic therapy, plus abandonment of intraperitoneal drainage, have reduced mortality from 44% to 5%

► [Most experienced surgeons in this field would strongly disagree with this author's observation that surgical intervention after 24 hours is contraindicated in perforated peptic ulcer The concept on which this recommendation is based "that the perforation is usually sealed by this time and that the peritoneum and omentum are better able to accomplish removal of the peritoneal contaminants than is transabdominal drainage," is fallacious and reflects inadequate experience with this problem —Ed]

Perforated Peptic Ulcer Immediate and Long Term Sequelae A *Tom Matheson*[5] (*Royal United Hosp , Bath, England*) reviewed a series of 115 perforated peptic ulcers, treated by simple suture where possible The 92 patients who sur-

(5) Brit J Surg 43 641 645 May 1956

vived the perforation or its immediate complications had a follow-up of 4 10 years Gastric perforations were proportionally more often fatal than were duodenal perforations Age was important in influencing the immediate fatalities A perforation was always lethal in women over age 60 and usually in men over age 70 In younger patients, death was often associated with systemic disease Incidence of reperforation was 11% In every instance, the cause was duodenal ulcer, and patients were notably younger than average

Further operation (partial gastrectomy where possible) was performed in one third of the survivors All but 2 of these 30 patients had had duodenal perforations It was estimated that half of all patients with perforated peptic ulcer would require definitive surgery subsequently Early relapse after perforation was important in necessitating further operation, and pyloric obstruction was the commonest complication for which partial gastrectomy was performed The over-all mortality for gastrectomy was 13%

The patient's course after perforation was unpredictable Perforations in women were more serious than those in men, all 6 women over age 60 died, and the 4 younger women did poorly after perforation An ulcer which had once perforated evidently proceeded more quickly to fibrosis and penetration A posteriorly penetrating ulcer often followed treatment of an anterior duodenal perforation Four patients, 3 of whom had ulcers were cured symptomatically by the perforation

► [Dr Matheson s study confirms those of other investigators that the incidence of recurrence of ulcer disease following treatment of perforated ulcer by simple closure is high For this reason primary gastric resection at the time of perforation which has long been advocated in European clinics has received increasing favor in recent years in this country particularly in light of the fact that it may be applied with equal if not with less risk than the more conservative procedure of simple closure in the presence of adequate personnel and facilities This is well demonstrated by the report of the group from the University of Washington which immediately follows this comment as well as by our own experience which now includes approximately 200 cases with an operative mortality of about 2% —Ed]

Treatment of Perforated Peptic Ulcer Report of 437 Surgical Cases is given by Andrew J Martinis Hilding H Olson and Henry N Harkins[6] (Seattle) There were 401 men and

(6) West J Surg 65 72 80 Mar Apr 1957

36 women, more than half of whom were age 50 or over Of these, 132 (30 2%) had no previous symptoms suggestive of gastric or duodenal ulcer Concomitant bleeding occurred in 74 (16 9%), manifested by guaiac-positive stools and only rarely by massive hemorrhage

The over all mortality from perforated peptic ulcer, including those cases found only at autopsy, was 99 (22 6%)

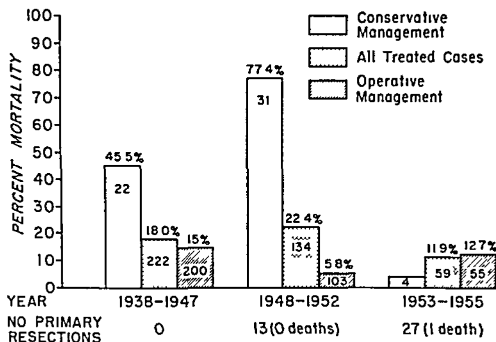


Fig 81—Evaluation of mortality rates by periods and methods used Numbers in hollow squares refer to total number of patients treated in that group (Courtesy of Martinis A J *et al* West J Surg 65 72 80 Mar Apr 1957)

The rate increased with increasing age and with delay in operation

The therapeutic approaches were (1) conservative management by continuous gastric suction, antibiotics transfusion parenteral fluids, (2) laparotomy with simple closure of the perforation with a tag of omentum and (3) primary subtotal gastrectomy Conservative management was unsatisfactory Primary or early elective gastric resection yielded the lowest mortality incidence and gave the best ultimate results Even though an increasing number of patients were treated by primary gastric resection, the over all mortality decreased (Fig 81)

Statistical Data on Incidence of Gastrectomy in Alcoholics from the literature and their own experience were reviewed by E Martimor, J.-F. Dereux and P. Nicolas-Charles[7] (Paris). Gastrectomy for ulcers is done about four times oftener in alcoholics hospitalized for neurologic or psychiatric disease (5-20%) than in other mental patients or in the general population (1-2%). Statistics collected by West and Hecker in 1951 showed that the incidence of ulcers in the general population and in nonalcoholic psychotics was about equal.

Compared with gastrectomies, there are significantly fewer ulcers treated medically or operated on as emergencies because of perforation In most patients, the sequence of events is alcoholism, ulcer, gastrectomy and internment Among other chronologies, the occurrence of alcoholism after gastrectomy is particularly important The prognosis for this clinical type of patient is unfavorable if consumption of alcohol is not stopped, medical treatment is difficult in stomachs of reduced size, and there is little possibility for effective psychotherapy.

At present, it is difficult to confirm or deny the hypothesis that gastrectomized alcoholics constitute, even before operation, a particular group of alcoholics, it appears rather that this group is quite heterogeneous.

Vagal Resection in Treatment of Duodenal Ulcer. A A MacKelvie[8] analyzed results of surgical treatment of 473 consecutive patients with duodenal ulcer. Vagal resection alone was done in 118 Of 105 patients with proper follow-up, 23 required gastroenterostomy for symptoms secondary to the vagal resection, such as gross gastric retention with foul flatulence and diarrhea In all these patients, the vagal section appeared complete. Thus, in 28%, vagal resection alone was a failure, and the need to relieve gastric retention so often by a second operation condemns it

Vagal resection combined with retrocolic gastroenterostomy was performed in 332 patients Operative mortality was 2 7% Excellent results were obtained in over 90% of patients Equally good results may probably be obtained by

(7) Presse med 64 1393 1394, Aug 11, 1956
(8) Brit M J 1 321 323, Feb 9, 1957

vagal resection with pyloroplasty Results are at least as good as those after partial gastrectomy, and operative mortality is probably appreciably lower These good results and the fact that partial gastrectomy is not excluded as a further possibility in resistant cases indicate that the combined operation should be the method of choice in treatment of duodenal ulcer

Duodenal Ulcer: Treatment by Vagotomy and Removal of Gastric Antrum Leonard W Edwards, J Lynwood Herrington, Jr, Samuel E Stephenson, Jr, Robert I Carlson, Reginald J Phillips, Jr, William R Cate, Jr, and H William Scott, Jr[9] (Nashville, Tenn) analyze results in 324 patients operated on from January 1947 to December 1955 Group I represented 188 private patients operated on by staff members of Edwards-Eve Clinic, group II (76) were staff and private patients operated on by resident or attending staff surgeons, group III consisted of 60 patients treated at Thayer VA Hospital Operations consisted of vagotomy and resection of the distal 35 50% (60% in a few cases) of the stomach Age range was 15-77 (average 46 7), 272 were males Duration of ulcer symptoms ranged up to 47 years, average 11 1 years Several patients with massive hemorrhage had no previous ulcer history Average hospital stay among group I patients was 9 days, group II, 11 days, and group III, 21 days There were 13 hospital deaths (4%), 6 of these in patients with massive bleeding who underwent emergency operation Six deaths occurred in patients with pyloric obstruction, and 5 of these had associated renal or vascular disease Among elective resections, the one fatality occurred in a man, 49, who had simultaneous excision of a pancreatic cyst and developed fatal postoperative hemorrhage

There were 42 significant postoperative complications (16 9%), delayed gastric emptying (11 patients) was most frequent Ten of 311 patients who survived operation subsequently died of unrelated causes, all had obtained a satisfactory result from the gastric operation Seven additional patients were lost to follow up, so results are complete on 294 patients (Fig 82)

Pain refractory to medical management (more prominent

(9) Ann Surg 145 738 752 May 1957

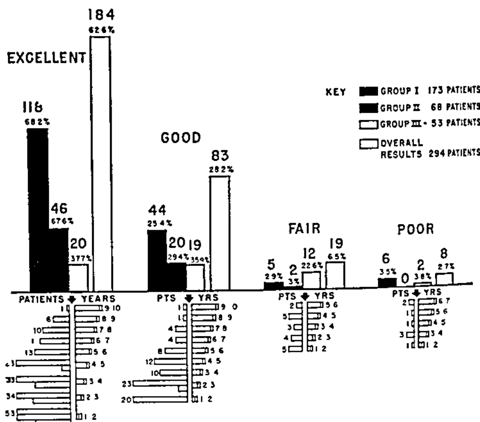


Fig 82—Results of vagotomy plus antrectomy (January 1947 December 1955) and period of follow up (Courtesy of Edwards, L W, *et al* Ann Surg 145 738 752, May, 1957)

RESULTS IN RELATION TO INDICATION FOR OPERATION

INDICATION	EXCELLENT	GOOD	FAIR	POOR	TOTAL
Pain	79 55 7%	48 33 8%	9 6 3%	6 4 2%	142
Hemorrhage	57 64 8%	24 27 2%	7 8%	0	88
Obstruction	43 75 5%	11 19 3%	2 3 5%	1 1 7%	57
Perforation	5 71 4%	0	1 14 3%	1 14 3%	7
Total	184	83	19	8	294

among young and middle-aged) was the primary indication for operation in 142 patients Hemorrhage (more frequent among older patients) was a more frequent indication than obstruction, which was not restricted to older persons but occurred relatively often in patients 41-50 Seven patients underwent vagotomy with antrectomy for acute perforation

They were seen within the first 12 hours following onset of symptoms and were judged to be good surgical risks Postoperative course closely parallelled that of a patient undergoing elective operation All 7 had a posterior penetrating ulcer in addition to the anterior wall perforation

Results were good or excellent in 93 6% of group I, in 97% of group II and in only 73 6% of group III Discrepancy in results of group III patients is possibly explained by the fact that in the Veterans Hospital many patients have lost incentive to return to gainful occupation and family responsibility Nevertheless, results of vagotomy and antrectomy were superior to those obtained with radical subtotal resection for duodenal ulcer in the same institution

Symptoms suggesting the dumping syndrome were observed in 68 patients (23 1%), the dumping was mild in most instances and at times was revealed only by careful questioning Symptoms were usually well controlled by restricting carbohydrates

The most significant fact derived from this follow-up study is that there has been no suspected or proved evidence of recurrent ulceration among 294 patients

Partial Gastrectomy versus Vagotomy with Gastroenterostomy in Treatment of Duodenal Ulcer Tilden C Everson, Vernon Z Hutchings, Jesse Eisen and Michael F Witanowski[1] (Univ of Illinois) state that during 1946 54, 348 patients with duodenal ulcers had a partial gastrectomy (Billroth II) and 178 with duodenal ulcers had vagotomy with gastroenterostomy The age and history of perforation were similar in the two groups The principal indications for surgery were obstruction and pain in both groups, but hemorrhage was an important indication in the partial gastrectomy group Most of the patients in whom an estimate was made had had two thirds or more of the stomach removed

Postoperative complications occurred in 37 7% of the partial gastrectomy group and in 25 8% of the vagotomy group Wound complications occurred about equally in both Pulmonary complications occurred in 12 7% of the partial gastrectomy group and in 4 4% of the vagotomy group Postoperative abdominal complications occurred in 14 6% of the

(1) A M A Arch Surg 74 547 554 April 1957

vagotomy group and in 11 2% of the partial gastrectomy group Commonest abdominal complications after vagotomy were diarrhea, gastric atony and stomal obstruction The commonest abdominal complication after partial gastrectomy was duodenal stump leak, which occurred in 3 5% Cardiovascular complications occurred in 5 2% of the vagotomy group and in 2 4% of the partial gastrectomy group

The postoperative mortality was 4 9% in the partial gastrectomy group and 1 1% in the vagotomy group Mortality rate after partial gastrectomy was 2 9% when the indication for surgery was other than hemorrhage In the 17 patients who died after partial gastrectomy, death was secondary to duodenal stump leak in 7 Of 12 with duodenal stump leak 7 died In 6 of the 7 who died, drains had not been placed near the duodenal closure at operation, whereas intraperitoneal drains (Penrose) had been used in the 5 who lived

Recurrent ulceration proved at surgery and/or by x rays was noted in 2 2% of 231 patients after partial gastrectomy and in 7 6% of 131 after vagotomy with gastroenterostomy Presumptive recurrent ulceration (hematemesis and/or characteristic ulcer pain) was noted in 1 7% of patients with partial gastrectomy and in 5 3% who had vagotomy with gastroenterostomy

No difference was noted in the percentage of patients below average healthy weight between partial gastrectomy and vagotomy with gastroenterostomy and likewise no difference in the incidence of the dumping syndrome

Of the survivors 92 6% followed after partial gastrectomy and 84% followed after vagotomy with gastroenterostomy were satisfied with the operative result However, including those who died after the operation among dissatisfied patients, patient satisfaction was 86 3% after partial gastrectomy and 82 7% after vagotomy with gastroenterostomy

Gastrectomy by Exclusion for Duodenal Ulcer 82 Cases in 3,000 Gastrectomies are reported by R de Vernejoul Ed Henry, R Devin and R Courbier[2] (Univ of Marseille) Despite its limited indications gastrectomy by exclusion is an excellent operation which saves some patients from serious biliary-pancreatic or fatal complications It is indicated prin-

(2) J chir 73 129 147 February 1957

cipally in patients in whom ulcer resection is contraindicated However great the experience of the surgeon, gastroduodenectomy cannot be done in certain rare cases without undue risk of injury to the bile duct, pancreas or a large vessel Choice of gastrectomy by exclusion is dictated principally by (1) site of the ulcer and (2) periulcerous inflammatory reaction

The technic differs according to whether the ulcer is situated distally in the duodenum or on the bulb, with inflammatory cicatricial sclerous reaction involving the upper portion and posterior surface of the duodenum and the entire pyloric region When the ulcer is remote from the bulb, in the 2d segment, the section is carried to the 1st segment of the duodenum and the pylorus entirely freed Instances where suturing and embedding of the stump are carried out in healthy tissue and healing is uncomplicated are, unfortunately, considerably less frequent than those in which contraindications to resection are due to pancreatitis with sclerous reaction, which interdicts section of the duodenum in pathologic tissue and demands section at the antrum with conservation of the pylorus To free the pylorus in these patients requires section of the 1st segment of the duodenum in a completely sclerous zone, often in contact with the ulcerated area, with suture in diseased tissues, which increases the risk of duodenal fistula and all its consequences In these instances, it is preferable to conserve the pylorus with section of the antrum, after complete removal of all gastric mucosa from the site of antral section to the pyloric orifice The section will then be carried to the antrum and followed immediately by removal of the mucosa with conservation of a healthy musculoserous layer and a stump presenting less risk of fistulization

Gastrectomy by exclusion should thus fulfil two purposes (1) assure physiologic conditions by suppression of the zone of acidity and (2) avoid fistulization of the duodenal stump The first will be achieved by complete ablation of all antropyloric mucosa and resection of the stomach in two layers, the second by a rigorous technic of closing the pyloroduodenal stump, perfection of the gastrojejunal anastomosis and suppression of all reflux of gastric contents in the duodenal area

Description and Justification of New Curative Operation for Peptic Ulcer: "Reversed Gastrectomy." Classic subtotal gastrectomy for peptic ulcer is a typical "functional" operation. Its purpose is the complete modification of the endogastric environment. The only test of its success is thorough *achlorhydria. To attain this, gastrectomy uses an effective* subterfuge. It leaves untouched the air pouch and part of the body which are the acid-secreting area, but inhibits secre-

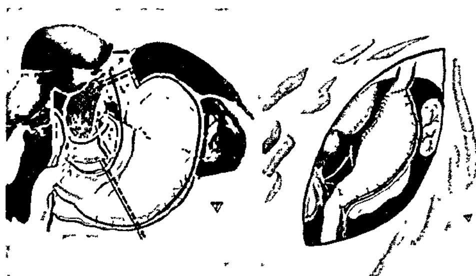


Fig 83 (left) —Limits of resection
Fig 84 (right) —Appearance of stomach after "reversed gastrectomy"
(Courtesy of Deloyers, L Ann Roy Coll Surgeons England 18 277 286, May, 1956)

tion by removing the pyloric antrum where "gastrin" is produced However, *the acid part of the stomach* which is preserved, although inhibited by removal of the alkaline area, indefinitely keeps a secretory potentiality. Sometimes the rest of the stomach may resume acid secretion and start a new ulcer cycle. To prevent this, L. *Deloyers*[3] (*Univ.* Libre de Bruxelles) advocates a "reversed gastrectomy" by which the acid-forming area of the stomach is removed and the alkaline-producing area of the antrum (Fig 83) is preserved.

TECHNIC —Through a thoracotomy incision, the pleura is split just above the diaphragm, and the lower esophagus is freed The diaphragm is severed The vessels of the greater curvature are ligated downwards, up to 10-12 cm. from the pylorus. The left gastric ves-

(3) *Ann Roy Coll Surgeons England 19 277 286, May, 1956*

sels of the stomach are then ligated. Between the antrum and body, two parallel lines of silver clips are applied and the stomach resected between them. The antral cut edges are approximated by a continuous suture from the lesser curvature to a point located at a distance of the greater curvature twice the diameter of the esophagus. The esophagus, which has been severed obliquely just above the cardia, is anastomosed with the free cut edge of the antral pouch on the greater curvature, using an inner layer of interrupted sutures and an outer layer of mattress sutures (Fig. 84). A Levin tube is left in the stomach for continuous aspiration. The diaphragm is closed above the esophagogastric anastomosis. The mediastinal pleura is sutured. A wide catheter is led out through a small incision in the 10th intercostal space posteriorly, and the thoracotomy incision is closed.

This technic is valid for all the locations of the ulcerative diseases: cardia, lesser curvature, antrum, duodenum and jejunum. Pyloric stenosis may represent a contraindication. The technic may be used also for marginal ulcerations following gastroenterostomy.

Treatment of Chronic Duodenal Ulcer by Antroduodenectomy and X-irradiation: Interim Report. Grayton Brown and I. J. Wood[4] (Melbourne) tried the combination of antroduodenectomy with end-to-end anastomosis followed by x-irradiation for treatment of severe duodenal ulcer. Among 142 patients operated on, there were 3 immediate postoperative deaths (all in patients with either a large or a distally placed ulcer). The ulcer usually was located with ease by careful inspection and palpation. If there was any doubt, the anterior wall of the duodenum was opened to enable direct inspection of the posterior surface—the commonest site for an ulcer. Subsequent examination of 94 resected specimens revealed that in 18% the ulcer had penetrated the duodenal wall; in 79%, the proximal edge of the ulcer crater was 1 cm. or less from the pylorus.

Of the other 139 patients, 100 were followed for 12-50 months; 52 were subjected to antroduodenectomy and x-irradiation and a control series of 48 had antroduodenectomy but no irradiation. In the irradiated group, progress was very good in 46 and poor with recurrent ulcer in 6 (symptoms were minor in 2). In the nonirradiated group, progress was very good in 37, moderately good in 5 and poor with recurrent ulceration in 6 (symptoms were minor in 1). Thus,

(4) Lancet 2:169-171, July 28, 1956

x-irradiation appeared to have no significant effect in reducing the recurrence rate However, there was some evidence that x-irradiaton delays onset of symptoms In view of the recurrence rate of 12%, this method of treatment should either be abandoned or modified to lessen recurrence

Since most of the recurrent ulcers appear on the suture line, every endeavor should be made to *procure healing of* the suture line by first intention Some weeks of preoperative treatment in the hospital will allow the inflammatory reaction around the ulcer to subside However, large ulcers or ulcers distally placed should not be treated by this method The section of the duodenum should be made sufficiently distal to the ulcer to allow optimal healing of the suture line, and fine interrupted catgut should be used for the mucosal sutures

► [The use of irradiation therapy in peptic ulcer was abandoned years ago because it was found to be worthless and in some instances deleterious It is difficult to understand how the addition of a worthless measure to a therapeutic regimen can enhance its efficacy It is not surprising therefore that these authors observed no significant benefits from the additional use of irradiation therapy —Ed]

Billroth I and Billroth II Operations Comparison of Results 6-10 Years after Operation for Gastric, Duodenal and Gastrojejunal Ulcers Waltman Walters and Thomas E Lynn[5] (Mayo Clinic and Found) present the results of the Billroth II operation for peptic ulcer in 729 patients The operative mortality was 1 7% Recurrences were proved in 3 7% of the patients and suspected in 1 6% There were proved recurrences in 3 6% of those with duodenal ulcer, 2 9% with gastric ulcer and 8% with gastrojejunal ulcer (table) The sex incidence was essentially equal except among patients with gastric ulcer, in which all proved recurrences were in men Excellent or good functional results were achieved in 92% Disregarding ulcer recurrences, another 2% of the patients continued to have severe postgastrectomy symptoms

Comparison was made with 185 patients who had the Billroth I procedure for peptic ulcer The average amount of stomach resected approximated two thirds in both groups The over all percentage incidence of proved and suspected recurrences in the Billroth I series was twice that in the

(5) A M A Arch Surg 74 680 685 May 1957

Billroth II series For gastric ulcer, the incidences of proved recurrences were essentially equal in the 2 series For duodenal ulcer, the incidence of proved recurrence in the Billroth I series was twice that in the Billroth II series The limited use of the Billroth I operation for duodenal ulcer, however, prevents authoritative comparison For gastrojejunal ulcer,

RECURRENCES 6 10 YEARS AFTER BILLROTH OPERATIONS FOR PEPTIC ULCER

SITE OF ULCER AND OPERATION	TRACED CASES	RECURRENCES			
		Proved		Suspected	
		No	%	No	%
Peptic ulcer total					
Billroth II	729	27	3.7	12	1.6
Billroth I	185	12	6.5	5	2.7
Duodenal ulcer					
Billroth II	449	16	3.6	9	2.0
Billroth I	27	2	7.4	2	7.4
Gastric ulcer					
Billroth II	139	4	2.9	0	—
Billroth I	113	5	4.4	1	0.9
Pyloric or combined gastric and duodenal ulcers					
Billroth II	54	0	—	0	—
Billroth I	19	0	—	0	—
Gastrojejunal ulcer					
After gastroenterostomy					
Billroth II	76	4	5.3	3	3.9
Billroth I	24	5	20.8	1	4.2
After gastric resection					
Billroth II	11	3	27.3	0	—
Billroth I	2	0	—	1	—
Total					
Billroth II	87	7	8.0	3	3.4
Billroth I	26	5	19.2	2	7.7

the rate of recurrence after the Billroth I series was nearly 2½ times that after the Billroth II series Again the Billroth I operation was used too infrequently to allow critical comparison There were no proved or suspected recurrences in either series in the treatment of combined gastric and duodenal or pyloric ulcers

Comparison of functional results in Billroth I and Billroth II operations failed to reveal any significant difference

Billroth I Gastrectomy The Billroth I operation has many advantages over the Polya procedure It restores the gastrointestinal tract to a more nearly normal condition both ana-

tomically and physiologically The various mechanical hazards associated with a loop, such as afferent loop obstruction burst duodenal stump, volvulus and intussusception, are eliminated Bile and pancreatic secretions enter the digestive tract in the normal sequence and mix fully with the food The possible disturbances caused by a bypassed section of bowel are avoided Paul Hickinbotham[6] considers the functional results of the operation considerably better than those of the Polya operation, a view which is becoming increasingly widely held by surgeons experienced in both types of gastrectomy

There are few instances in which, with care and persistence a Billroth I operation is not possible, and it is at least as safe as the Polya procedure The technic of the Billroth I operation requires that there be no tension and that the stomach and duodenum have an adequate blood supply The former can be insured by mobilizing the greater curve of the stomach fully so that if necessary, only the last vas brevis is left The Billroth I operation is the procedure of choice in gastric ulcers However, it is not suited to duodenal ulcers because of a high recurrence rate

Twenty-five Years' Experience with Billroth I Gastric Resection is reported by Guy W Horsley and Walter C Barnes (St Elizabeth s Hosp , Richmond Va) in 271 patients Operation was for duodenal ulcer in 110, gastric ulcers in 97 gastric malignancy in 63 and carcinoid of the stomach in 1 Follow-up was directed to the referring physician and the patient If the patient required no particular diet or medication, was free of disability and satisfied with the result the classification was excellent Patients with any difficulty since surgery, mild anemia or inability to gain weight or those who had an occasional dumping syndrome were classed as having a good result Those with recurrence or progression of the disease or with anastomotic ulcers were classed as unimproved

Of the 110 patients with duodenal ulcer 102 were traced and 70 reported excellent and 14 good results only 6 were unimproved Of these 6, 3 reported recurrent ulcers 2 had additional bleeding and 1 a marginal ulcer A total of 12 died

(6) Brit J Surg 44 206 208 September 1956
(7) Ann Surg 145 758 766 May 1957

11 before 1946 Of the 97 patients with gastric ulcers, 89 were followed, and 71 reported excellent results, 8 good results, and only 4 were unimproved The 6 deaths in this series occurred before 1946 The postoperative death rate in patients with gastric malignancies was high, because many had palliative resection only, however, 18% survived 5 years

The Horsley modification of the Billroth I operation unites the stomach and duodenum along the lesser curvature The lower portion of the gastric stump may be infolded and further protected by suturing adjacent peritoneum-covered fat to this point, assuring safety of the suture line To avoid obstruction, an incision 2-3 cm long is made along the anterior wall of the duodenum to flare it open, giving a larger caliber at the union with the stomach This modification requires less mobilization of the duodenum, and more stomach can be removed without undue tension on the line of anastomosis By anastomosis of stomach to duodenum, a high degree of gastric acidity may be tolerated and more normal gastrointestinal physiology preserved With this operation, good to excellent results were obtained in 89% of gastric and 83% of duodenal ulcers Patients maintained their weight, and marginal or recurrent ulcers were minimal

► [It is apparent from the 3 preceding articles that interest in the Billroth I procedure for duodenal ulcer continues Evidence is accumulating however, to indicate that the incidence of marginal ulceration is higher after this procedure than after the Billroth II operation particularly if a limited resection is done This may ultimately outweigh the advantages of the operation As observed by Mr Hickinbotham the Billroth I procedure would seem to be particularly useful in the treatment of gastric ulcer in which the incidence of recurrent ulceration is low —Ed]

Study of Motility in Gastric Remnant Following Subtotal Gastrectomy Gastric retention occurring 8-10 days after subtotal gastrectomy commonly is attributed to stomal edema, with hypoproteinemia, hyperhydration and hyper natremia incriminated as contributing factors However, some observers have found the enteric stoma widely patent at re exploration George L Jordan, Jr , Harry L Barton and Willie A Williamson[8] (Houston) studied by various methods the degree and significance of motility in the gastric remnant of 46 patients between the 9th and 15th postoperative days

Recordings of intragastric pressure revealed minimum mo-

(8) Surg Gynec & Obst 104 257 267 March 1957

tility In some patients, no gastric contractions were observed However, most patients had 6 12 contractions, ranging from 5 to 15 mm Hg in amplitude during the 1-hour observation period after ingestion of the test meal Only 3 had contractions exceeding 15 mm Hg Varying the type of test meal had no effect (Fig 85)

X ray studies showed that barium ingested in the upright position passes rapidly by gravity directly into the jejunum When the gastric remnant is filled, that portion of the meal at the stoma gradually is moved on by jejunal peristalsis As the barium column progresses through the jejunum the

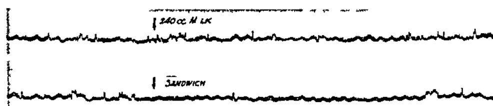


Fig 85 —Tracings of motility in gastric remnant 10 days postgastrectomy showing minimal response to liquid or solid stimulus (Courtesy of Jordan G L, Jr *et al* Surg Gynec & Obst 104 257 262 March 1957)

remaining barium is displaced from the stump of the stomach, with resultant decrease in size of the stump of the stomach Coughing, talking and voluntary changes in intra abdominal pressure cause small spurts of barium to pass quickly through the stoma because of compression on the pouch Thus it appears that normal gastric tone jejunal peristalsis, changes in the intra abdominal pressure, diaphragmatic motion and gravity probably are the primary factors in emptying the gastric remnant Consequently, gastric atony is not a primary factor in development of postoperative retention

In the authors' experience gastric retention after subtotal gastric resection has been caused by mechanical obstruction of the efferent loop

Fecal Fat and Nitrogen Studied in Postgastrectomy Patients Relationship of Fat and Nitrogen Excretion to Weight Loss and Comparison between Billroth I and Billroth II Subtotal Gastrectomies R Edward Robins, H Rocke

Robertson and Hamish W McIntosh[9] (Vancouver) did metabolic studies in the form of fecal fat and nitrogen excretion in 20 postgastrectomy patients who had been operated on an average of 3 years previously for peptic ulcer and who had good results Half the patients had a Billroth I and half a Billroth II type subtotal gastrectomy Vagotomy had been combined with subtotal gastrectomy in 5 patients There was no significant difference in the number losing weight in the two groups, nor in the number who gained weight or the amount of weight gained

A definite tendency to elevation of fat excretion and nitrogen excretion in postgastrectomy patients was found However, in most patients elevation was only to a borderline level, and only a few showed abnormal elevation No direct relationship between elevation of fat and nitrogen excretion and weight loss was observed

These studies suggest that in postgastrectomy patients food intake is probably the most significant factor in weight gain or loss Vagotomy accompanying partial gastrectomy appeared definitely associated with increased fat and nitrogen excretion In comparing Billroth I and Billroth II type postgastrectomy patients, there was no significant difference as a group in increased fat or nitrogen excretion

Physiologic Alterations Resulting from Carbohydrate, Protein and Fat Meals in Patients Following Gastrectomy: Relationship of These Changes to Dumping Syndrome Albert Medwid, Jacob Weissman, Henry T Randall, Harry N Bane, Parker Vanamee and Kathleen E Roberts[1] (New York) confirmed earlier observations that carbohydrate meals and hypertonic solutions may precipitate an acute drop in blood volume and ECG changes coincident with dumping symptoms in patients following gastrectomy Their findings also substantiated the postulated mechanism which has been outlined to explain the alterations associated with the dumping symptoms according to the following chain of events (1) the entry of foodstuffs directly into the jejunum, (2) rapid enzymatic hydrolysis of food, with a corresponding increase in osmolarity, (3) a shift of fluid from the extra

(9) Surgery 41 248 253 February 1957
(1) Ann Surg 144 953 960 December 1956

cellular compartment to the jejunal lumen in an attempt to maintain jejunal contents isotonic with the plasma, (4) a resultant decrease in circulating plasma volume and at times a decrease in blood pressure resulting in (5) sympathetic stimulation emanating from pressoreceptor mechanisms, (6) ECG changes consistent with myocardial ischemia and (7) a decrease in cardiac output

The authors found that protein foodstuffs were quantitatively less effective than carbohydrate in producing the cardiovascular alterations and the dumping symptoms The effects of carbohydrate food substances were observed in the patients with esophagoileocoloduodenostomy and in a patient with an esophagojejunoduodenostomy and were similar to those observed in the patients with esophagojejunostomy esophagoduodenostomy and Roux en-Y cervical esophagojejunostomy

A diet of a low carbohydrate, moderate fat and high protein content given at frequent feeding intervals resulted in weight gain and partial relief of symptoms

Comparative Evaluation of Dumping Syndrome after Partial Gastrectomy and after Vagotomy with Gastroenterostomy was made by Tilden C Everson, Vernon Z Hutchings Jesse Eisen and Michael F Witanowski[2] (Chicago) *A study of the incidence of the dumping syndrome in* patients operated on for peptic ulcer demonstrated that at the time of follow-up at least minimal symptoms of the dumping syndrome were present in 53% of 318 patients after partial gastrectomy compared with 52% of 118 patients after vagotomy with gastroenterostomy Comparable symptoms of the dumping syndrome were found in 2% of 100 control (orthopedic and peripheral vascular) patients

No clearcut progressive increase in the incidence of the dumping syndrome was noted with increasing estimated percentage of gastric resection Only a small percentage of patients reported disappearance of the symptoms of the dumping syndrome with duration of time after operation

It is suggested that the dumping syndrome is an important factor in the etiology of weight loss after gastric operations However it is not the only factor involved since ap

(2) Ann Surg 145 182 186 February 1957

preciable losses of weight were also noted in some patients without the dumping syndrome.

Postgastrectomy Syndrome is discussed by H. Krieger Lassen[3] (Randers, Denmark). The sequelae which may develop in patients after gastric resection for gastric or duodenal ulcer are dumping, weight loss, anemia, neurasthenia, recurrent ulceration, jejunal or marginal ulcers, hemorrhage, cancer of the stomach remnant, biliary regurgitation, diarrhea or constipation, difficulties in gastric emptying, gastritis, anastomositis or jejunitis, vitamin deficiencies and pulmonary tuberculosis.

Dumping consists of troublesome reactions, such as a sensation of heat, sweating, possibly associated with coldness and clamminess of the skin, weakness, unrest, pallor, anxiety, a sensation of hunger or epigastric fulness, nausea or vomiting, faintness, headache and palpitation. Some of these reactions occur just after meals; others occur ½-1 hour later. The severity of the reactions often fluctuates; periods with complete absence and severe exacerbations may alternate, and hard physical work usually aggravates the symptoms.

In addition to the purely mechanical factors in dumping, recent investigations reveal that the blood sugar curve is abnormal, with a steep initial rise, later followed by subnormal values. Electrocardiographic changes, suggestive of potassium deficiency, have also been shown. Weight loss, if any, is not caused by disturbances in nitrogen or fat metabolism, but is referable to the asthenic type of the patient and to reduced food intake. Anemia is most frequently due to the exclusion of the duodenum brought about by the Billroth II type of gastrectomy, because absorption of iron principally occurs in the duodenum and the upper part of the jejunum. The occurrence of pulmonary tuberculosis may possibly be ascribed to lowered resistance to infections in general, referable to leukopenia.

Follow-up studies on 163 of 165 surviving ulcer patients subjected to gastrectomy showed excellent results in 52.8%, fair in 37.4% and poor in 9.8%. Mild dumping was present in 36% of the patients with fair and poor results. Only 5 patients had a hemoglobin level below 80%. Pulmonary tuberculosis developed in 2.

(3) Acta med scandinav. 155 475-483, 1956

Postgastrectomy Syndrome: Studied on Pathogenesis Complications of gastroduodenal ulceration may be managed effectively by subtotal gastrectomy, which results in relief from symptoms in 95-98% of patients However, in a relatively high percentage of patients, a new set of symptoms develops in the postoperative period that may be as disabling as the condition for which they were treated In fact, unsatisfactory results after gastrectomy are more commonly caused by postgastrectomy sequelae than by recurrent ulceration

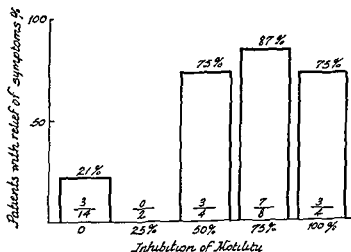


Fig 86 —Correlation of inhibition of postprandial jejunal motility with relief from symptoms (Courtesy of Jordan, G L, Jr, *et al* Ann Surg 145 471 478 April 1957)

Many theories have been advanced to explain the pathogenesis of the dumping syndrome, and one of the most popular is that symptoms result from jejunal distention

George L Jordan, Jr, Robert C Overton Michael E De Bakey[4] (Houston) studied the significance of jejunal distention and motility in relation to the dumping syndrome, and the effect of antispasmodic agents An attempt was made to correlate objective physiologic changes with symptomatology by determination of motility without distention or obstruction of the intestine

Measurement of pressure changes in the jejunum during the fasting and postprandial period showed jejunal hyper motility in 16 of 20 patients with the dumping syndrome

(4) Ann Surg 145 471 478 April 1957

Banthine® and hexamethonium considerably reduced fasting jejunal motility in most patients, but inhibition of postprandial motility was less common. The effect of Dactil® on motility during fasting was inconstant, but its postprandial effect was as great as that of Banthine® or hexamethonium. Partial or complete relief from symptoms occurred in 81% of the patients in whom administration of one of the antispasmodic drugs was followed by 50% or more inhibition of postprandial hypermotility (Fig. 86).

The authors believe that most patients with the dumping syndrome have jejunal hypermotility in the postprandial period. This probably accounts for the nausea, vomiting and diarrhea that may occur but probably does not account for the vasomotor symptoms.

Peripheral Blood Flow and Blood Volume Studies in Dumping Syndrome were performed by David B. Hinshaw, Eugene J. Joergenson, Harry A. Davis and Clarence E. Stafford[5] (Los Angeles). The dumping syndrome, which appears in some patients after gastric resection, is characterized by epigastric discomfort, nausea, palpitation, tachycardia, weakness, syncope, often a feeling of warmth, and sometimes explosive diarrhea. Rapid gastric emptying results in intrajejunal hyperosmolarity, with a compensating shift of extracellular fluid and plasma into the jejunal lumen to achieve isotonicity. Consequently, a reduction in circulating plasma volume occurs.

The authors found increased peripheral blood flow in many patients with dumping symptoms. This seems to be closely related to the systemic symptoms of the dumping syndrome, such as syncope, tachycardia and weakness.

It is suggested that patients who exhibit severe systemic manifestations in dumping attacks have abnormal homeostatic vascular responses to sudden reductions in plasma volume.

► [Interest in postgastrectomy sequelae has led to the delineation of several syndromes which may be differentiated by proper evaluation of the patient. The syndrome referred to in the 5 preceding papers has been called the "dumping syndrome" for lack of better terminology but is separate and distinct from the afferent loop, the hypoglycemic and other syndromes.

As indicated in the above papers, there are a number of physiologic alterations which occur during the symptomatic period. Only about a year

(5) A.M.A. Arch. Surg. 74:686-693, May, 1957.

ago it appeared that the changes in blood volume and gastrointestinal motility offered adequate explanation for the postprandial symptoms However, the changes in peripheral blood flow recently reported by Dr Hinshow indicate a more complex physiologic alteration than had previously been appreciated The mechanism by which peripheral vasodilation is produced despite the fall in blood volume requires further investigation —Ed.]

Special Aspects of Sequelae of Gastrectomy for Ulcer in North Africa are discussed by H Comte[6] (Casablanca French Morocco), who agrees with others that gastrectomy for duodenal ulcer in North African patients is a disaster and vagotomy perhaps even worse Poor results are not due to inferior surgery but to poor risk clinical material, resulting from climate, poor living habits, defective diets and an ethnic type characterized by leanness and vagotonia Protein and vitamin deficiencies, intestinal infections parasitic infestations, anemia and exhaustion conspire to make the North African Arab exceptionally prone to various complications after gastric surgery Another complication in some cases is mistaken diagnosis of ulcer, especially in multiple mesenteric adenopathy, periduodenitis of amebic origin and initial stages of peritoneal cirrhosis

In North Africans, gastrectomy leads to nutritional disturbances and serious dumpings in 20 30% of cases For these patients, some authors have recommended gastroenterostomy with or without vagotomy Comte believes that vagotomy can be useful if it is accompanied by an antropylorectomy This operation tends to conserve almost entirely the gastric reservoir while avoiding the serious consequences of anacidity that may attend total or partial gastrectomy

Results of this operation were evaluated in follow up of 92 of 198 patients operated on (mortality 1%) More women than men were re examined Results 1-4 years after operation were good in 94 5% Only 4 patients were unable to work Considering the type of patients, these results were extraordinarily good Low incidence of nutritional disturbances, diarrhea vitamin deficiency or anemia indicated little interference with alimentary absorption Only 6 patients (7%) lost weight contrasted with 40% who lost weight after subtotal gastrectomy

External Fistulas of Digestive Tract Following Gastric Operations are discussed with illustrative cases, by

(6) Maroc Médical 35 618 645 June 1956

M. Broggi[7] (Barcelona). These fistulas occur oftenest in the excluded duodenal stump in gastrectomies of Billroth II type.

CASE 1.—Woman had pain and rigidity in the right upper quadrant 9 days after subtotal gastrectomy. Insertion of a permanent gastric tube and partial reopening of the laparotomy wound yielded no drainage. The next day the rigidity extended toward the right inguinal region, where there was a point of maximal tenderness. A small incision yielded an abundant flow of bile, and suction drainage was established. The patient was fed parenterally for a few days until intestinal motility was re-established, when continuous drip was given through a Levin tube. Much of the fluid aspirated from the fistula was readministered. The fistula closed in 12 days, and the patient recovered completely.

If drainage through an inguinal incision had been deferred, the condition would have progressed to a fatal generalized peritonitis. Reopening the abdominal incision was unsuccessful because the colon was interposed between the duodenal stump and the abdominal wall. Since the fistula was not total, feeding by simple intubation was possible.

CASE 2.—Woman had sudden, acute abdominal pain in the right hypochondrium 5 days after duodenotomy. Within a few hours, a large quantity of bilious fluid was aspirated through a tube inserted into the laparotomy wound. In the following days, despite administration of parenteral fluids, the patient's condition deteriorated rapidly. Loss of fluid through the fistula was so copious that in 3 days blood chlorides fell and alarming alkalosis developed. Jejunostomy was then done under local anesthesia, and continuous drip was begun with water, salts, nutrients and all fluid obtained from the fistula. By the 10th day, drainage from the fistula ceased, but jejunal feeding was continued until the 15th day. By the 17th day, the catheter was withdrawn from the jejunum, and the patient was discharged in good condition.

In this patient, the fistula was in the lateral wall of the duodenum and was total, with rapid denutrition. The possibility of passing a tube to bypass the lesion in such instances is uncertain; the most rapid and infallible treatment is immediate jejunostomy, which allows compensation of fluid and nutritional loss. Although in this case the operation was a duodenotomy, the fistula was of the same type as those seen after gastrectomy with terminoterminal anastomosis.

CASE 3.—Man had a resection of the upper two thirds of the stomach and lower esophagus with intrathoracic esophagogastric anastomosis. Postoperatively, there were signs of pyloric retention, which impeded re-establishment of nutrition by mouth. After 15 days, a fistula developed through the pleural opening from which the drainage

(7) Rev españ. enferm. ap. digest. 15:421-426, Mar.-Apr., 1956.

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(7) Rev españ enferm ap digest 15 421-426 Mar Apr 1956

tube had been withdrawn 7 days earlier Aspirative drainage of the fistula and intubation through a jejunostomy were instituted The fistula still persisted 30 days later X-rays showed that the anastomosis was permeable but that the pylorus was stenosed and was being emptied with great difficulty Gastroenterostomy, which was difficult because of the high position and small size of the remaining stomach solved the problem The fistula closed and the patient began to take food by mouth

Fistulas which occur in high or total resections of the stomach at esophageal anastomoses are extremely important, because they constitute the most frequent cause of death after this type of operation Conservation of the pylorus is important in production and maintenance of these fistulas, *since it tends to close because of interruption of the vagus* Only jejunostomy assures nutrition of the patient for an extended period Many of these fistulas occur in the pleural cavity, which presents less defensive resistance than the peritoneum When anastomosis is within the thorax the pleura should be drained by means of a thick tube maintained in position long enough to produce canalization of the tract This assures conduction of leakage to the outside in case of posterior fistula, thus saving the pleura and mediastinum

CASE 4—Woman had a rare gastrocutaneous fistula after opening of a perigastric abscess Everything ingested, the gastric juice and reflux of duodenal fluid flowed continuously through the fistula Because of extreme denutrition, jejunostomy was done, through which aspiration from the fistula was replaced After 2 months the patient's condition was good and the fistula was healed

The principles of therapy are the same in all cases of external fistulas of the digestive tract (1) Drain the fistulous tract by aspiration, avoid retention and, *to hasten cure*, maintain the skin in good condition and collect fluid for readministration (2) Assure nutrition by a method which can be maintained as long as necessary and which permits administration of large quantities of fluids No other method fulfils these requisites so well as jejunostomy Except in the case of fistula of the excluded duodenal stump, in which permanent intubation could be accomplished by the natural route all patients required jejunostomy

Embryologic and Anatomic Approach to Treatment of Gastric Cancer Improvement in results of surgical treatment for cancer of the stomach depends on the development of

safe technics for more complete excision of the primary lesion and its lymphatic drainage area

From embryologic and anatomic considerations, it appears necessary to restore the primitive gastric mesentery with its contained spleen, pancreas, blood vessels and lymphatics so as to perform an effective block excision of carcinoma of the stomach. On this principle Joseph A. Visalli and Orville F. Grimes[8] (Univ. of California) developed the following technic for more complete removal of neoplasms of the proximal third of the stomach.

TECHNIC.—The patient is placed on the right side in the three-fourths lateral position and supported with sandbags beneath the left shoulder and hip. The incision is begun 1 in. below the right costal margin at about the midpoint of the right rectus muscle and is continued obliquely up and to the left to meet the left 7th intercostal space. The abdominal cavity is opened and explored to determine operability of the gastric lesion. If resection is possible, the left costal arch is divided in the 7th intercostal space and the incision extended along the 7th interspace to the posterior axillary line. As the incision is opened, the diaphragm is divided toward the esophageal hiatus for a distance consistent with optimum exposure. The esophageal hiatus is not entered. A large rib spreader is placed across the divided costal arch and the intercostal muscles divided as far posteriorly as required without extending the skin incision.

Mobilization of the lesion is begun by incising the lienorenal ligament allowing the spleen to be rotated medially. The embryologic fusion plane behind the pancreas is entered and opened by gentle blunt dissection. This dissection is carried to the point where the inferior mesenteric vein crosses behind the pancreas to join the splenic and superior mesenteric veins to form the portal vein. The greater omentum is taken off the left half of the colon by incising its filmy attachment to the large intestine.

The en bloc dissection which proceeds from above downward is then begun by incising the peritoneum overlying the cardioesophageal junction. Both vagus nerves are divided, allowing about 2 in. of esophagus to be drawn down into the abdomen. If there are no palpably enlarged lymph nodes above the diaphragm, the crura of the diaphragm are not divided, but if the supradiaphragmatic lymphatics are involved the dissection can be extended to begin at the level of the inferior pulmonary vein. The lymphatic and areolar tissue overlying the diaphragmatic crura is dissected cleanly downward as the lesser omentum is divided flush with the liver hilus. The left gastric artery is ligated exactly at its origin from the celiac axis. The splenic artery is easily identified and similarly ligated at its origin. The splenic vein is ligated just proximal to its confluence with the portal

(8) Surg. Gynec. & Obst. 103: 401-408, October, 1956.

vein The pancreas is divided and *repaired* at the junction of its body and head

The entire specimen is then lifted out of the wound, preserving the right gastroepiploic and gastric arteries, and the stomach is divided at the *junction* of the body and antrum The subpyloric and right suprapancreatic nodes overlying the gastroduodenal artery and pancreatic *head, and the main* superior mesenteric nodes may be readily removed, since *the portal* vein and superior mesenteric artery now lie completely exposed

The lateral duodenal peritoneal reflection is incised, and the duodenum *is mobilized toward* the midline so the anastomosis between the esophagus and gastric antrum may be done without tension The opening in the antrum of the rest of the stomach is repaired A separate stab incision is made in the *anterior wall of* the antrum just *distal to the repaired end*, and an anastomosis is made to the end of the esophagus No attempt is made to fix the anastomosis below the diaphragm It remains where it lies *after retraction of the esophagus* usually within the esophageal hiatus A Ramstedt or Heineke *Mikulicz pyloroplasty* is then performed Chaffin air vent suction drainage of the pancreatic bed may be employed advantageously

The authors performed this operation on 10 patients There were no operative deaths, although 3 patients died of complications of the operative procedure The other 7 patients had an uneventful convalescence and remained clinically well up to a year despite the fact that several were aged 70 or more

Lymphatic Spread of Cancer of Stomach Observed in Operative Specimens Removed by Radical Surgery Including Total Pancreatectomy Robert E L Berry and William Rottschafer[9] (Univ of Michigan) studied the lymphatic spread of advanced cancer of the stomach in 5 specimens removed at total gastrectomy, total pancreaticoduodenectomy and *splenectomy*, 2 other specimens were studied that *included* *removal of 80%* of the pancreas, but in which the duodenum was left intact

Specimens contained 37-78 nodes The highest incidence of metastatic involvement was 68 of 73 nodes the lowest, 1 of 37 so isolated The 2 most undifferentiated tumors had the highest incidence of lymph node involvement Involvement of the splenic chain nodes was demonstrated in 5 of 7 specimens Ligation of the splenic artery at its origin from the celiac axis and complete removal with attendant nodes and

(9) Surg Gynec & Obst 104 269 279 March 1957

connective tissue were necessary in 4 of 5 specimens if these nodes were to be adequately removed Examination of the anterior and posterior pancreaticoduodenal nodes in 5 specimens showed no involvement Thus, excision of the head of the pancreas to remove only these nodes does not appear worthwhile

Little clinical benefit attended these operations The hospital mortality was 72% In 2 patients leaving the hospital, death from recurrence occurred 3 and 5 months after operation It is felt that total gastrectomy with total pancreaticoduodenectomy is unsatisfactory for cancer of the stomach

► [The conclusion reached by these authors that total gastrectomy combined with total pancreaticoduodenectomy is not a satisfactory procedure for cancer of the stomach seems to be well justified, both by their experience and that of others —Ed]

Results of Treatment of Gastric Cancer 15 Years Experience with 201 Resections O Olsson, A Westerborn and R Endresen[1] (Goteborg) reviewed the outcome of 201 resections for gastric cancer, in a series of 464 patients Treatment usually consisted of partial gastrectomy, with removal of the greater omentum and the major part of the lesser omentum Anastomosis was usually established by Billroth II and in a few cases by the Billroth I operation In 25 patients, total gastrectomy was done with resection of the low part of the esophagus In most patients under 55 the tumor was operable Of the patients with gastrectomy, 52 2% were under age 60 Operability did not vary with sex

For the graphic representation of the survival rate the authors recommend a logarithmic diagram because it permits direct comparison of mortality at different periods and in different series The mortality rate during the first month after gastrectomy was about 32%, with a distinct tendency to decrease toward the end of the investigation

Not even a follow-up of 7 years seems to be sufficient to judge end results of gastrectomy Of the gastrectomized patients, 24% survived more than 3 years and 16% more than 7 years Patients in the 6th to 8th decades had the same prospects of 3 year cure, but for those in the 5th decade prospects were brighter Both sexes tolerated the operation equally well, but males had better chances of a long survival

(1) Acta chir scandinav 111 1 15 1956

It is important to operate within 3 months of onset of symptoms A longer cancer history is accompanied by increased operative risks and shorter survival If metastases were present at operation prospects of a 3-year cure were 6%, as against 42% with no visible metastases

It is felt that results of operations performed at different hospitals cannot be compared because many factors influence the composition of the material

Importance of Gastric Mucosal Patch in Continuity with Alimentary Canal Following Total Gastrectomy: Experimental Study is presented by Wilfried Amann and Alexander

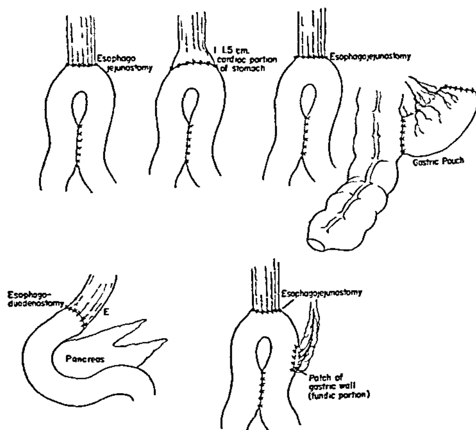


Fig 87—Various anastomoses after total gastrectomy performed in dogs (Courtesy of Amann, W and Brunschwig A Ann Surg 144 428-432 September 1956)

Brunschwig[2] (Mem'l Center for Cancer, New York) Relatively precarious nutritional status in patients surviving total gastrectomy has long been recognized The obvious explanation is absence of the stomach, which results in

(2) Ann Surg 144 428 432 September 1956

decreased efficiency of digestion Brunschwig has observed that in patients who undergo subtotal gastrectomy in which some gastric mucosa at the cardia is preserved, the postoperative nutritional status is not as profoundly affected as when there has been a frank esophagojejunostomy This suggested that gastric mucosa may contribute some factor to digestion, whether hormonal or external secretion, the deprivation of which is noxious to the organism and possibly is something apart from the phenomenon of proteolytic gastric juice acting on ingested food in a reservoir (the stomach) To test this hypothesis, various anastomoses after total gastrectomy were performed on dogs (Fig 87) It was found that implantation of a small retained patch of midstomach into the efferent loop of the jejunum (from esophagojejunostomy), partially, but effectively, reduced postoperative nutritional impairment

The authors suggest that fundic type gastric mucosa and cardiac mucosa may elaborate an internal secretion that in some way may be concerned with nutrition apart from the external secretion of proteolytic gastric juice

Evaluation of Various Operative Methods for Total Gastrectomy. Total gastric resection has become easier and its operative risk diminished greatly due to improvements in operative technic, selective anesthesia and the employment of antibiotics The ideal or preferred operative method has not been established Known postoperative difficulties, such as agastric anemia, loss of weight and dumping syndrome or stricture of the esophageal remnant, were previously so great that the impulse was often to perform palliative procedures rather than a radical attempt to cure Komei Nakayama[3] (Chiba Univ) evaluated operative methods for total gastric resections in treatment of gastric carcinoma based on 316 total gastrectomies with a mortality rate of 2 84%

Esophagoduodenostomy, after total removal of the stomach, is technically easiest Various clinical investigations performed on certain patients after operation revealed that minimal operative stress and most prompt recovery follow esophagoduodenostomy However, this method is not applicable when the lesion infiltrates the esophagus

(3) *Surgery 40 488 502 September 1956*

Postoperative stricture at the anastomosis is most frequent after esophagoduodenostomy Careful operative technic is required to avoid stricture Agastric anemia is found most often following esophagojejunostomy This is due to passage of food by detouring the duodenum Digestive and absorptive ability of the nutritive elements are better maintained with jejunal transplantation

The 5-year postoperative survival rate (approximately 10%) is about the same by all methods Transplantation of the resected intestinal loop between the esophageal and duodenal remnant seems preferable if the patient's general condition is good enough to tolerate such severe operative stress Esophagojejunostomy seems least desirable

► [The mortality rate reported by Dr Nakayama is remarkably lower than that reported in most American clinics The reported 5 year survival rate however, does not appear to have been improved by this radical procedure Total gastrectomy for cancer is recommended only when necessary to obtain an adequate margin of normal tissue around the lesion —Ed]

Congenital Diaphragmatic Occlusion of Duodenum with Report of 3 Cases According to John L Madden and William J McCann[4] (St Clare's Hosp, New York), the exact etiology of congenital diaphragmatic occlusion of the duodenum is unknown, but the defect occurs in the region of the papilla of Vater where the diverticula issue to form the liver and the pancreas embryologically (Fig 88) Intrinsic obstructions of the duodenum cause persistent vomiting which may be bloody and contain bile Deep icterus is common, as are other congenital malformations Epigastric distention and visible gastric peristalsis are prominent The dilated first portion of the duodenum may be palpable

Diagnosis of duodenal obstruction must be considered in every newborn with persistent vomiting X rays of the abdomen in erect and inverted positions show the gas filled stomach and first portion of the duodenum, with few or no gas shadows in the rest of the intestines Barium or iodized oil swallows demonstrate the lesion Congenital obstructive anomalies of the duodenum must be differentiated from esophageal atresia and infantile pyloric stenosis In atresia of the esophagus, vomiting occurs during rather than after, each feeding and is associated with varying degrees of cyanosis The vomitus consists of unchanged feeding and does

(4) Surg Gynec & Obst 103 1 15 July 1956

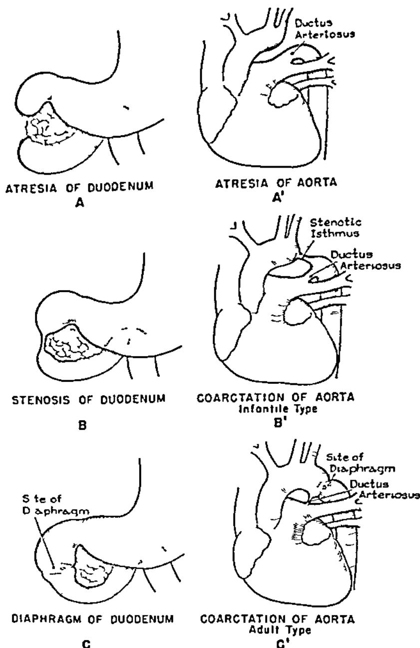


Fig 88—Analogy between congenital defects of duodenum and those of aorta Similarity of diaphragmatic occlusion of duodenum (*C*) and coarctation of aorta (*C'*) is well illustrated. (Courtesy of Madden J L and McCann, W J Surg Gynec & Obst 103 1 15 July, 1956)

not contain bile Swallows of iodized oil demonstrate the defect In infantile pyloric stenosis, vomiting is usually delayed until age 3 or 4 weeks, and the vomitus does not contain bile In pyloric stenosis, there is a preliminary progressive gain in weight and maintenance of adequate nutrition,

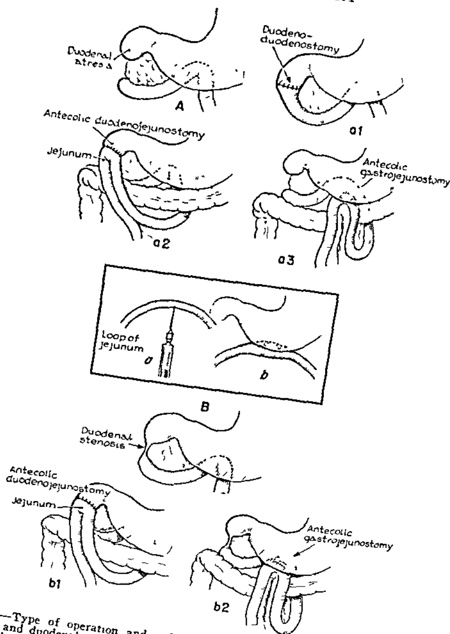
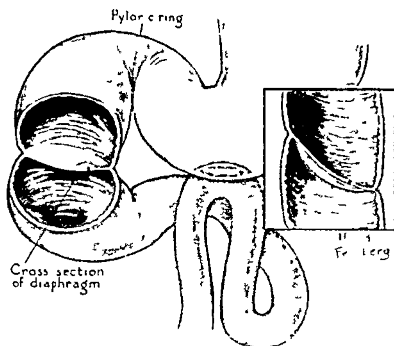


Fig 89—Type of operation and order of preference in treatment of duodenal atresia (*A*) and duodenal stenosis (*B*) Inset *a*, *b* shows technic for enlarging lumen of intestine by injection of sterile saline solution to facilitate performance of anastomosis. (Courtesy of Madden, J L, and McCann, W. J Surg, Gynec & Obst. 103 1-15, July, 1956)

whereas in duodenal obstruction, the progress from birth is generally one of rapid deterioration. Absence of cornified epithelial cells in smears of meconium indicates congenital atresia of the gastrointestinal tract

The most important factors in treatment are early diag-



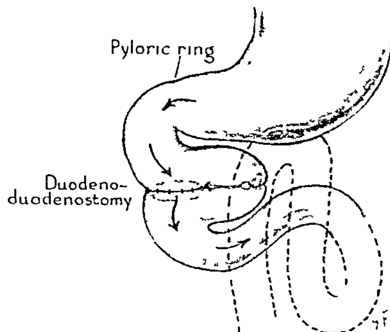


Fig 90 (top) —Symmetrical dilatation of duodenum above and below diaphragm, eccentric perforation constriction or indentation of wall of the duodenum at site of attachment of diaphragm and previous gastroenterostomy Inset shows oblique (45 degrees) position of diaphragm

Fig 91 (bottom) —Side to-side duodenoduodenostomy to bypass obstruction caused by diaphragm

(Courtesy of Madden J L and McCann W J Surg Gynec & Obst 103 1 15, July 1956)

nosis and operation Operations include duodenoduodenostomy, duodenojejunostomy and gastrojejunostomy (Fig 89). Other possible operations are duodenotomy and excision of the diaphragm or a Horsley pyloroplasty with a longitudinal incision across the diaphragm and transverse closure When the duodenum is being sutured, care must be taken not to injure the bile and pancreatic ducts

There have been 86 reported cases from 1824 to 1955 plus 3 new cases reported by the authors The patients, aged day of birth to 72 years, most commonly had a perforated diaphragm placed obliquely (45 degrees) across the lumen at the level of the ampulla of Vater The 2-10 mm orifice was usually eccentric Sixty-five operations were performed in 48 1% Operative mortality was 33 9% and case mortality was 52 3%

Boy, 10, had intermittent attacks of vomiting of progressive severity At age 1 year a retrocolic gastrojejunostomy was performed for persistent vomiting since birth X-rays showed obstruction in the second portion of the duodenum and an adequately functioning gastrojejunostomy Exploration revealed a boggy, dilated duodenum and an indentation in the outer wall of the mid descending portion of the duodenum (Fig 90) A side-to side duodenoduodenostomy was performed (Fig 91) X-rays postoperatively showed successful bypass of the diaphragmatic occlusion Recovery was complete

Primary Malignant Neoplasms of Duodenum: Discussion Based on 17 Cases, with Emphasis on Radiologic Diagnosis is presented by Seymour Ochsner and Martin S Kleckner Jr [5] (New Orleans) The patients were aged 42-80 Adenocarcinoma was found in 14 and sarcoma in 3 Eight of the lesions were in the suprapapillary, 6 in the peripapillary and 3 in the infrapapillary region Suprapapillary tumors produce symptoms principally of pyloric obstruction, peripapillary tumors, often labeled ampullary carcinoma or carcinoma of the ampulla of Vater, cause obstructive jaundice, and infrapapillary tumors lead to gastrointestinal hemorrhage

Only x ray studies can provide early enough recognition of tumors involving the duodenum to allow resection These lesions must be differentiated from chronic duodenal ulceration with deformity or stenosis, pancreatic tumors, congenital or postoperative adhesions and benign duodenal tumors Excision of these duodenal neoplasms is the only treatment

(5) J A M A 163 413 417 Feb 9 1957

that promises any hope for survival of a long-term nature

Evaluation of Temporary Gastrostomy Substitute for Nasogastric Suction Decompression of the stomach is desirable, simple and logical for prevention and/or treatment of gastric dilatation and ileus complicating abdominal operations Common complications of intubation are laryngeal obstruction, ulceration and late stricture of the esophagus and perforation of the stomach or intestine To determine the approximate number of these complications, a questionnaire was directed to specialists in laryngology and bronchoesophagology by Jack Matthews Farris and Gordon Knight Smith[6] (Univ of California, Los Angeles)

The 59 physicians who responded reported 260 major laryngeal or esophageal complications of nasogastric intubation, of which 79 required tracheostomy and 22 esophageal dilatation Several patients required mediastinal closure and 7 died The presence of the tube is unpleasant and uncomfortable Ulcerations of the ala nasi, excoriation of the septum, acute pharyngitis, tubotympanitis and otitis media are common Positioning of the tube is difficult A tube in the nasopharynx results in dysfunction of the esophageal constrictors, actually increasing the amount of air entering the intestinal tract One placed distally in the lower intestine requires air to travel all the way to the tube tip before it is aspirated, and attempts to treat adynamic ileus with a long tube actually aggravate the situation

Gastrostomy obviates all these difficulties At the close of the definitive surgery, the stomach is sutured to the anterior abdominal wall, fusing the peritoneal surfaces A purse-string suture is placed in the lower half of the stomach and a no 18 or 20 Foley bag catheter (balloon inflated to about 10 ml) is introduced and brought out through a small stab wound in the left subcostal area The tube is connected to either a water sealed bottle or the usual suction apparatus It has remained in place as long as 2 weeks Removal is usually followed by prompt healing

Temporary gastrostomy was done in 115 instances with excellent results It is a safe and acceptable substitute for nasogastric suction

(6) Ann Surg 144 475 484 September 1956

Malrotation of Intestine is discussed by W H Snyder and Lawrence Chaffin[7] (Univ of Southern California) The ill effects of malrotation are due to a partial or complete block or several blocks in the passage of intestinal contents along the alimentary canal The surgeon operates for intestinal obstruction The patient is usually a newborn baby or one under age 3 weeks, who has usually been vomiting bile stained material In less than half of 40 cases reviewed by the authors examination of the abdomen revealed distention or other clinical evidence suggesting small intestine obstruction In the rest, clinical examination of the abdomen was not helpful in preoperative diagnosis X-ray studies, a flat film of the abdomen, a swallow of Lipiodol® and especially a barium enema are exceedingly helpful and should not be delayed too long in a baby that continues to vomit

Exploration for suspected intestinal obstruction without apparent cause is usually through a right rectus incision If there is gas in the terminal ileum and colon and no obvious point of obstruction, a hand inserted up toward the ligament of Treitz may reveal a twisted mesentery In any event, removal of all the intestine at once from the abdomen onto warm sponges will avoid useless tracing out of loops of bowel and freeing of scattered adhesions without a definite plan With the incision long exposure good and the small intestine removed from the abdomen, the following procedure is recommended (1) If there is a volvulus of all the small intestine, it should be untwisted (2) Whether this is present or not, beginning with the stomach, the position of the duodenum and jejunum should be noted In most cases, the jejunum will not emerge beneath the transverse mesocolon at the usual position of the ligament of Treitz but will be attached on the anterior aspect of the mesentery of the small or large bowel (3) The cecum and right colon must be freed from their right upper quadrant attachment Bands cross

(7) S Clin North America 36 1479 1494 December 1956

the duodenum which cause obstruction and must be severed.

In most instances, the duodenojejunal loop will be to the right and the cecocolic loop to the left of the superior mesenteric artery If the bowel has been freed adequately to demonstrate this, then the causes of the obstruction will be relieved and likelihood of recurrence will be minimal Undoing the volvulus of the small intestine and severing the obstructing bands across the duodenum are essential Freeing the attachment and kinks of the jejunum and placing the duodenum and jejunum along the right gutter will further decrease immediate and late postoperative obstructions Complicating anomalies which can be determined at operation include duodenal atresia, Meckel's diverticulum and absence of one kidney and ureter

Duodenal and Jejunal Diverticula are discussed by Howard L Elstner and John M Waugh[8] (Mayo Clinic and Found) Primary nonmeckelian diverticula typically are located along the concave or mesenteric border of the bowel, are thin walled and contain no muscle tissue in the walls Etiology is obscure Secondary diverticula contain all the layers of intestine and result from traction and scarring of adjacent inflammatory processes The reported incidence based on x ray examination ranges from 0 016 to 5 76% Most commonly, duodenal diverticula are discovered in the 5th and 6th decades of life, in the second or descending portion of the duodenum, mostly on the concave border

Most duodenal diverticula are asymptomatic If symptoms do occur, the most common is pain in the upper abdomen, usually occurring after large meals and relieved totally or partly by belching, vomiting, antacids or antispasmodics This pain may simulate biliary colic or the pain of peptic ulcer Extension to the back has been noted Other common symptoms are nausea and loss of weight Less commonly seen are spontaneous vomiting, jaundice and diarrhea The first indication of a pathologic process may be an acute abdominal crisis or gastrointestinal hemorrhage Complications include inflammation, enteroliths, ulceration, perforation, fistula formation, hemorrhage or obstruction of the duodenum, common duct or pancreatic duct, leading to jaundice

(8) Surgery 41 674 685 April 1957

or acute pancreatitis A duodenal diverticulum may undergo neoplastic change, both carcinoma and sarcoma have been reported

Jejunal diverticula are the rarest diverticula of the gastro intestinal tract They occur in the later decades of life and are more common in men Jejunal diverticula may cause no clinical symptoms or mild abdominal discomfort or gaseous dyspepsia Mechanical obstruction is the commonest com plication Diverticulitis without obstruction may occur

Surgery is best reserved for complications and incapaci tating symptoms Resection with end-to end anastomosis is the procedure of choice in jejunal diverticula, and total re moval is preferred to inversion or side-tracking procedures in duodenal diverticula Removal of a duodenal diverticu lum may be hazardous, especially if the diverticulum is ad jacent to the ampulla of Vater Duodenal fistula formation is another factor causing high mortality and morbidity Sur gery for duodenal diverticula is beneficial in about 50% of cases

Indications for Surgical Intervention in Regional Ileitis Burrill B Crohn[9] (Mount Sinai Hosp, New York) believes there is no adequate and satisfactory conservative treat ment for regional ileitis Of 700 patients, only 10 made a spontaneous recovery Neither supportive therapy with a high protein diet, vitamins and physical rest nor radiother apy or psychotherapy will achieve any singular beneficial results Antibiotic therapy is used only if there are suppura tive complications Steroids offer the best specific therapy The contraindications to surgery are extensive ileojejunitis with diffuse involvement of the whole or large part of the small bowel, acute ileitis, mucosal enteritis and combined ileocolitis

Positive indications for surgery are the presence of a mass fever, diarrhea pain internal fistulas and a lesion localized in the terminal ileum Patients with abdominal wall and perirectal fistulas have irreversible complications which de mand surgery About 5% of patients have hemorrhage which must be treated surgically Intestinal obstruction is usually a late manifestation of the disease and must be corrected

(9) A M A Arch Surg 74 305 311 March 1957

surgically Ileitis, which recurs after previous surgery, is usually a medical problem, but if the medical management of the recurrence fails, surgical intervention is justified Persistent activity in the primary lesion after an attempted short-circuiting operation must be treated surgically Perforation with the formation of a mass surrounding a purulent cavity is a surgical indication

If a course of conservative therapy, supportive, antibiotic and steroid, has been given and nothing may be gained by further delay, operation is timely X-rays will have demonstrated that the lesion in the bowel is static and has failed to extend upward beyond the recognizable skip-lesions Further delay only invites more anatomic extension to internal bowel fistulas and perirectal complications

The best operative procedure is short-circuiting of the lesion by ileocolostomy, with a transection of the ileum 10-18 in above the uppermost point of discernible affection of the bowel This procedure has practically no operative mortality Some medical centers advocate resection of the lesion at the risk of a mortality of 2 3% Both procedures have the same recurrence rate, thus, the safer short circuiting procedure is probably the better It is generally felt that transection of the ileum above the affected loop of bowel is mandatory to localize the lesion and prevent upper extension of the disease subsequently The type of anastomosis of ileum to colon varies with individual surgeons

The actual recurrence rate of ileitis after conventional and accepted methods of surgery is difficult to evaluate and ranges from 22 5% to as high as 66% A differentiation must be made between clinical and radiologic recurrences A radiologic demonstration of recurrence is followed sooner or later by clinical symptoms Most recurrences appear within 1 year of surgery, but some have occurred 21 years later The recurrence is always in the ileum The presence of Brunner-like glands or increased ganglion cells in the ileum may cause recurrence of the disease

Primary Tumors of Small Bowel E Lee Strohl and Willis G Diffenbaugh[1] (Chicago) analyzed 28 tumors of the jejunum and ileum There were 11 carcinomas, 7 sarcomas, 4

(1) A M A Arch Surg 74 709 718 May 1957

carcinoid and 6 benign tumors Of the malignant tumors 16 were in the ileum and 6 in the jejunum

Marked weight loss was the most significant symptom occurring in 82 1% of the patients Recurrent episodes of partial intestinal obstruction, with pain and abdominal cramps, were present in 75% Pain, appearing 30 60 minutes after meals and usually located around the umbilicus oc curred in 57 1% Nausea and vomiting usually followed the cramps and pain Diarrhea, frequently following an attack of partial obstruction, was noted in 25% Severe anemia was observed in 64 2% of patients Distention of the abdomen with hyperperistaltic activity was seen in 57 1%

Because of the frequency of obstruction, scout films of the abdomen are important Use of barium most commonly shows a dilatation proximal to an area of constriction Re tention of barium in the small bowel for more than 8 hours suggests a lesion Surgery gave poor results with malignant and good results with benign tumors

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THE APPENDIX

Acute Appendicitis in Infancy and Childhood is discussed by J J Mason Brown[2] (Univ of Edinburgh) The incidence of acute appendicitis in younger children is increasing There has been a steady fall in mortality, although diagnosis is being made no earlier than it was 20 years ago The older the child, *the more likely that diagnosis will be* made in the first 24 hours of illness, the younger the child the greater the probability that diagnosis will not be made until the symptoms have been present for more than 3 days The posi tion of the appendix accounts for only a small fraction of late diagnoses

Delay in diagnosis frequently results from failure to con sult the doctor but often the patient s condition is not diag nosed when the doctor is called in soon after onset of illness The undramatic onset absence of a ' textbook symptomatol ogy" and frequency of simple abdominal upsets in children contribute to late diagnosis

(2) J Roy Coll Surgeons Edinburgh 1 268 284 June 1956

Pain is the most important symptom of acute appendicitis, but it is not the first symptom in almost 1 of every 5 patients Although there may be exacerbations, pain usually is constant Until perforation occurs, pain frequently begins and remains at a site corresponding to that of the appendix

The child under age 3 presents a less definite symptomatology He is peevish, fretful, fevered and refuses all food Vomiting is an early and persistent symptom, and diarrhea is more frequent than in the older child Pain is not the predominant feature

The symptomatology is so variable that the only solution is constant vigilance and suspicion of the appendix in a child of any age with abdominal symptoms of any kind

Although in older children appendical abscesses of several days' duration may be treated conservatively in some instances, there is virtually no place for delayed treatment in childhood and none in children under age 5 Wound drainage is used when there is seropurulent peritoneal fluid and when removal of a gangrenous perforated appendix has led to soiling of the wound Peritoneal drainage is reserved for localized collections of pus and involvement of cellular tissues in the pelvis or retrocecal space In perforation of the appendix with more than slight contamination of the peritoneum, parenteral antibiotic therapy (penicillin and streptomycin) is used In spreading or generalized peritonitis, Terramycin® is given

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THE COLON AND RECTUM

Antibiotic Support of Colon Anastomoses was investigated by Isidore Cohn, Jr, Don Langford and James D Rives[3] (Louisiana State Univ), who developed a technic for study of a devascularized colon anastomosis after preoperative mechanical cleansing They found that such cleansing permitted devascularization of longer segments of colon adjacent to an anastomosis than could be performed in an unprepared colon The survival rate for this procedure in untreated dogs was 40%, compared with 100% in treated dogs After heal-

(3) Surg Gynec & Obst 104 1 7, January, 1957

ing, the devascularized colon was indistinguishable from the normal

It is felt that antibiotics prevent perforation, slough and leakage at the anastomosis, maintain viability and function of the devascularized segment and permit complete recovery of the animal These studies do not provide full evidence for the necessity for preoperative antibiotic preparation of the colon rather than simple mechanical cleansing, but they do show that an adequate postoperative antibiotic level is valuable in promoting healing of a colon anastomosis

Critical Analysis of Intestinal Antisepsis The most important period during which intestinal bacterial inhibition should be maintained is that of early healing, which coincides with the period of paralytic ileus when nothing can be taken orally When an intestinal antiseptic is administered the doses should not be spaced more than 4 hours apart, because the effective agent will be swept out of the small intestine Unsustained suppression of bacterial growth favors the outgrowth of the resistant organisms Because intestinal surroundings are ideal for continued bacterial growth antibiotic agents must be maintained in unusually high concentrations

Edgar J Poth[4] (Univ of Texas) divides patients into 3 groups as to the clinical application of intestinal antisepsis (table) In the 1st group, those to whom purgatives can be given, the 3d stool after administration of castor oil, as indicated, is essentially sterile and usually passed within 3 hours The 2d group are those whose intestinal tract is obstructed but in whom obstruction is relieved by gastric suction and decompression The time required for preparation is highly individual and depends on how soon mechanical preparation of the intestine can be accomplished If the obstruction cannot be resolved, these patients are categorized in the 3d group, together with other patients requiring urgent abdominal exploration as a result of gunshot, stab and other traumatic wounds of the abdomen and strangulation obstruction Specific preoperative preparation of the intestine is contraindicated, and exploration is done as soon as the patient s general condition warrants

(4) J A M A 163 1317 1322 Apr 13 1957

Outline of Clinical Categories and Treatment of Patients Requiring Intestinal Antisepsis

<table>
<tr><th>Group 1</th><th>Group 2</th><th>Group 3</th></tr>
<tr>
<td>No obstruction purgation contraindicated
Preparation in 20 hr
Castor oil 60 cc neomycin 1 0 Gm and phthalylsulfathiazole 1 5 Gm at 1 p m
Then neomycin 1 0 Gm and phthalylsulfathiazole 1 5 Gm at 2 p m 3 p m 4 p m , 8 p m 12 midnight, 4 a m , and 8 a m
Operation scheduled for 9 a m</td>
<td>Partial obstruction purgation contraindicated
Gastric suction
Decompression
Bowel movements reestablished
When the obstruction has been relieved, neomycin 1 0 Gm and phthalylsulfathiazole 1 5 Gm given by mouth every four hours until mechanical preparation of the intestine has been accomplished usually a minimum of three days</td>
<td rowspan="2">Complete obstruction preoperative preparation of intestine contraindicated
Intra abdominal trauma
Perforations of intestine
Peritonitis
Exploration as soon as general condition of patient warrants
Evacuate peritoneal cavity
Add 500 cc of 0 5% solution of neomycin to peritoneal cavity*
Evacuate intestine
Flood intestine with as much as 1 000 cc of 1% solution of neomycin containing 250 units per cc of bacitracin
Evacuate peritoneal cavity, place 100 cc of 0.5% solution of neomycin into peritoneal cavity*
Wash wound with 100 cc of 0 5% solution of neomycin during closure*</td>
</tr>
<tr>
<td colspan="2">No additional time required for intestinal antisepsis When mechanical preparation completed the intestine is essentially sterile
Intestinal antisepsis maintained throughout period of postoperative paralytic ileus without administration of additional drug
If the intestine has been sutured neomycin 1 0 Gm , and phthalylsulfathiazole 1 5 Gm , are started again postoperatively and given every four hours as soon as peristalsis has returned</td>
</tr>
<tr>
<td colspan="3">Intestinal antisepsis is ended in each of the three groups by administering 10 000 units of bacitracin every four hours for three days and two tablets containing L acidophilus and L bulgaricus every eight hours for at least one week when the neomycin phthalylsulfathiazole combination is discontinued</td>
</tr>
</table>

* Addition to bacitracin in concentration of 500 units/cc might be indicated

If the peritoneal cavity is contaminated it is evacuated and 200 ml of 0 5% solution of neomycin containing 500 units bacitracin/ml is placed in the abdomen Practically all of this solution will be lost or aspirated during the operation However, its rapid action will destroy most of the bacteria in the peritoneal cavity and simultaneously irrigate the abdominal wound Should it be necessary to resect the intestine, do primary anastomoses, or repair large defects in the intestine decompression is accomplished transabdominally, and the entire small intestine and colon are flooded with as much as a liter of 1% solution of neomycin with bacitracin The solution is injected transmurally into the lumen of the intestine Within 30 minutes viable bacteria cannot be subcultured As the abdomen is closed 0 5% solution of neomycin with bacitracin is placed in the peritoneal cavity and the abdominal wall wound washed with the same solution during closure Most patients in whom this method of antisepsis is used experience an uncomplicated and afebrile postoperative course

Hirschsprung's Disease or Congenital Megacolon Surgical Treatment is indicated in all cases according to Pierre Petit and Jacques Decaudaveine[5] (Paris) Resection of the terminal nondilated segment of the intestine as first advocated by Swenson should extend upward to the dilated colon which is cut about 12 cm above the narrow segment Below resection should include the entire rectum to the anal canal 2 cm from the mucocutaneous margin followed by immediate anastomosis of the colon to the anus Risk of injuring the nerve plexus of the small pelvis and causing urinary or genital disturbances is averted *if rectal dissection is carried to the muscular coat*

Rectocolic resection can be done in 1 or several stages Swenson usually operates in 1 stage after careful preparation to evacuate and sterilize the colon He reserves colostomy for patients in whom it is impossible to evacuate the intestine and for children whose general state is precarious because of poor nutrition In these he does a colostomy on the distal portion of the distended colon and completes the operation in 2 stages The authors have found it practicable to operate

(5) J chir 72 521 535 June July 1956

in 3 stages right transverse colostomy, resection and closure of artificial anus Right transverse colostomy is a security factor, since it permits diversion of feces during cicatrization of the coloanal suture, but is not without complications At present, Swenson's practice is being followed increasingly Of the last 6 operations, 2 were done in 1 stage, 1 in 2 stages and 2 in 3 stages

The operation may be done at any age It is successful in young infants, but they often tolerate their anomaly poorly and their general state may become alarming In them, active medical treatment is attempted to restore biologic equilibrium before operation, but this is difficult and not always effective Thus, a low colostomy just above the lesion is often necessary in very young infants

The authors did 18 rectosigmoid resections for Hirschsprung's disease without a single fatality One secondary operation had to be done because of occlusion due to frenum, but disunion of the anastomosis has not been observed Twelve patients, aged 3 months to 16 years, were reexamined 2-5 years after rectosigmoidectomy Clinically, all improved rapidly and grew normally Rectal evacuations in 7 were normal and regular without enemas or laxatives In 2, enemas and suppositories were required and 3 had several semiliquid or liquid stools daily In some, normal intestinal transit was re established, with regular and spontaneous stools within a few days after operation In others, slight distention of the colon with retention of gas and liquid persisted for several months

Radiologically, the picture agreed with the clinical findings In half the patients, the colon appeared normal, and after evacuation, was empty In the other half, it remained slightly dilated and evacuation was incomplete It is difficult to interpret these facts, because all operations were the same, with histologic proof that the section of colon was carried into healthy tissue Apparently, functional results are better and obtained more promptly in older than in younger children

Three instances of anal incontinence were observed, although the anus appeared normal and the sphincter seemed to have excellent tonicity on rectal palpation It is suggested

that the resection should suppress the entire malformed intestinal segment, but should respect some millimeters of rectal mucosa to conserve the sphincter function

Resection of Colon for Hirschsprung's Disease is described by Orvar Swenson and John Herbert Fisher[6] (Tufts College) The term "Hirschsprung's disease" is used to designate the syndrome of chronic constipation from birth The

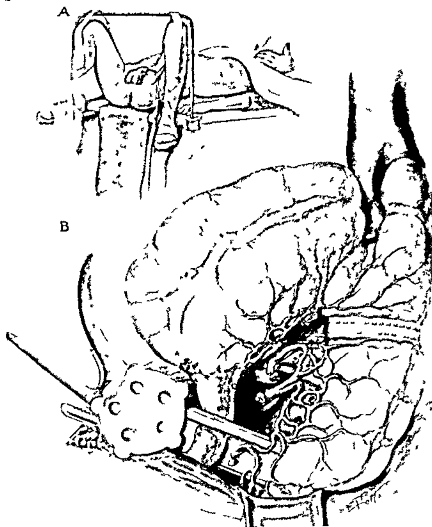
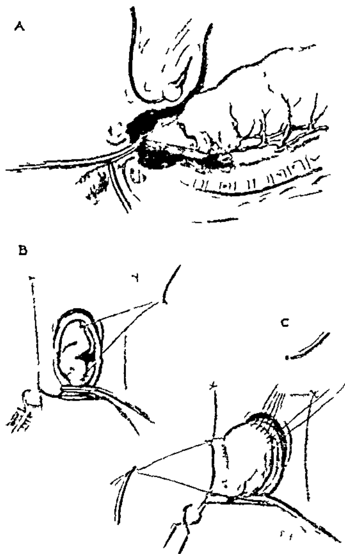


Fig 92 —*A*, child in modified lithotomy position to permit operative teams to work simultaneously at abdomen and perineum *B*, mobilized distal colon to be resected is divided between rows of staples applied by von Petz clamp Vascular arcades in mesentery are used to maintain viability of segment of proximal colon to be pulled through pelvis (Courtesy of Swenson, O, and Fisher, J H S Clin North America 36 821 829, August 1956)

(6) S Clin North America 36 821 829 August 1956

disease is characterized by intermittent episodes of lower intestinal obstruction with abdominal distention and is caused by congenital malformation of the sacral parasympa-



F[illegible] incision in rectum inverted out t[illegible]on and lower rectum made on pe[illegible] silk sutures approximating musc[illegible] H S Clin North America 36

thetic system consisting of absence of ganglion cells from Auerbach's plexus in a portion of the distal colon The length of colon involved varies, but includes the rectum down to the internal sphincter The lesion of the parasympathetic sys

tem may also involve the nerve supply to the bladder The normal bowel wall has clusters of large cells with finely granular cytoplasm (Nissl substance) surrounding the large nucleus which has at least one nucleolus Sections of distal colon in Hirschsprung's disease contain large bundles of nerve fibers but no ganglion cells The physiologic defect is absence of peristaltic activity in the distal colon This relative obstruction to the passage of gas and feces accounts for stasis of intestinal contents with dilatation of the colon proximal to the lesion X-rays reveal the narrowed aperistaltic distal segment Biopsy of the rectal wall shows the lack of ganglion cells Surgical treatment involves resection of the aganglionic lower colon with a pull-through anastomosis

TECHNIC —With the child in a modified lithotomy position, the abdomen is opened through a left rectus muscle retracting incision from the pubis to the umbilicus The distal aganglionic colon appears grossly normal, whereas the colon proximal to it is dilated and hypertrophied When the aganglionic segment extends into the sigmoid it is best to mobilize the entire left colon, including the splenic flexure If the lesion involves the rectosigmoid or rectum only, mobilization of the descending colon is unnecessary No more colon than the aganglionic lesion requires should be resected Mobilization of sufficient large bowel to reach through the anus after resection of the aganglionic segment requires division of mesenteric vessels These vessels should be divided near their origin from the inferior or superior mesenteric blood supply

Excision of the aganglionic segment is begun by dividing the mesentery near the colon The site of proximal resection is chosen in the dilated segment of colon 5-10 cm from the narrowed portion The von Petz clamp can be used The colon is then divided in the rectosigmoid (Fig 92), and the pathologist examines the removed segment to make sure that ganglion cells are found at the line of proximal resection Mobilization of rectosigmoid and rectum is carried out by dissection directly on the muscular coat of the bowel wall This is continued distally to within 2 3 cm of the mucocutaneous junction, ending just above the insertion of the levator ani muscles on the sides of the rectum The mobilized rectal stump is inverted out through the anus after gently dilating it The anal canal and 1 5 cm of rectal mucosa must remain attached to the sphincter or reflexes essential to continence may be destroyed

A second operative team performs the anastomosis Traction on the inverted rectal stump partially everts the anus An incision is made through the anterior third of the rectal wall 2 cm from the mucocutaneous junction, and an instrument passed into the pelvis (Fig 93) pulls the closed end of the mobilized segment of descending colon out through the incision in the rectal wall The first layer of the anastomosis between the descending colon and the lower rec-

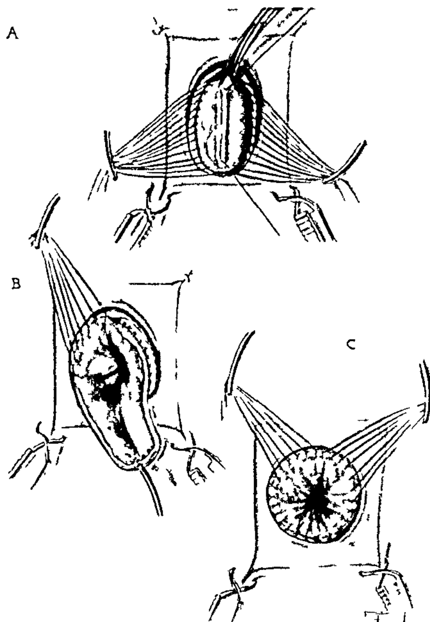


Fig 94—*A* after complet on of s lk suture of anastomosis stapled end of descend terrupted sutures of 5 0 chrom c *C* when long ends of mucosal (Courtesy of Swenson O and August 1956)

tum is made with interrupted 5 0 silk sutures about 1 mm apart through the muscular coats The incision through the rectal wall is continued around the sides as the first layer of anstomosis is com pleted The line of staples on the end of the bowel is removed The second layer of the anastomosis is interrupted 5 0 chromic catgut in the mucosal layers placed close enough together to cover the silk su tures (Fig 94) The bowel is released by cutting the long ends of

the sutures and the anal canal returns to its normal position The anastomosis retracts into the pelvis and rests 2 cm above the mucocutaneous junction

While the anastomosis is completed another operating team sutures the pelvic peritoneum to the colon The abdominal wound is sutured *in layers with uninterrupted fine silk to the peritoneum* fascia and skin

Outcome of Surgery for Ulcerative Colitis was investigated by B N Brooke (Univ of Birmingham) in 131 patients (84 women and 47 men) Elective operations were per



Fig 95 (left) —Patient at time of primary colectomy
Fig 96 (right) —Patient 2½ years later
(Courtesy of Brooke B N Lancet 2 532 536 Sept 15 1956)

(7) Lancet 2 532 536 Sept 15 1956

formed on 126 excision and permanent ileostomy in 117 and resection and anastomosis in 9 Operative and late deaths totaled 15, a mortality of 12%—about one-half the mortality with conservative treatment in the pre-cortisone era

Most late complications of operation arose in connection with the ileostomy To reduce incidence of stenosis, eversion suture of the mucosa to skin is advocated Revision of the ileostomy was required in some patients to enable them to use an adherent ileostomy bag

Follow-up, extending to 5 years and longer in over one third of the survivors, indicates that ileostomy is not an impediment to full, normal life Rather, ileostomy restores patients with ulcerative colitis to full work and full weight (Figs 95 and 96) and allows enjoyment of ordinary pastimes For about half the patients, the diet must be restricted slightly Ileostomy patients regard their ileostomies as satisfactory

Resection and anastomoses with preservation of the anal sphincter in this series has been less satisfactory than excision and permanent ileostomy After sphincter-saving resection, the disease may recur and complications may arise for the first time This method is not recommended as a routine and its indications are limited Its use is precluded for rectal hemorrhage and perforation—complications encountered in this series

Results of Subtotal Colectomy and Ileoproctostomy in Treatment of Chronic Ulcerative Colitis were studied by Charles W Mayo and C William Broders[8] (Mayo Clinic and Found) in 22 patients In 15, various degrees of involvement of rectum with chronic ulcerative colitis were present before operation After surgery, 21 patients gained weight, 20 were fully active and able to perform full-time jobs or household duties Control of bowel movements was present in 20 Slight bleeding from the rectum after operation was noted by 8 patients Postoperative complications included enterocutaneous fistula, rectal polyps, rectal fistula, anal fissure, intestinal obstruction, and obstruction of the small bowel from adhesions which required surgical intervention

Fate of Remaining Rectal Segment after Subtotal Colectomy for Ulcerative Colitis was studied by Charles W Mayo,

(8) Surg , Gynec & Obst 104 180 182 February, 1957

Orceneth A Fly, Jr, and Michael E Connelly[9] (Mayo Clini and Found) in 45 patients who underwent this procedure and in whom a rectal segment of varying length remained for more than 90 days

In 21 of 30 patients in whom the rectal segment was left intact and a resection planned for a later date, the segment was removed by combined abdominoperineal resection or posterior resection 3-28 months after the subtotal colectomy Pathologic examination of surgical specimens revealed ac tive chronic ulcerative colitis in 13 instances, malignant dis ease in 2, and severe submucosal scarring, contraction o strictures in 5

There were 9 patients in whom the distal segment of rec tum was preserved with the tentative plan for later ileoproc tostomy One of these patients underwent combined abdom inoperineal resection 5 months after colectomy because of continued activity of the disease, excessive bloody rectal dis charge and tenesmus Seven patients retained their distal rectal segments In 5 there was proctoscopic evidence of ac tivity of chronic ulcerative colitis in the rectal segment afte 11 years and 3, 6, 28 and 7 months, respectively One of these also had a persistent rectovaginal fistula In 2 patients, the rectum appeared free of disease One of these died 9 months after colectomy following revision of the ileac stoma Her general condition had not improved sufficiently to permit consideration of reconstruction One patient had shown no signs of active disease in the rectum, but reconstruction of continuity had been delayed because of fear of reactivating the disease

In 6 patients there was no plan for future anastomosis c posterior resection Three of these underwent resection o the rectal segment 4, 5 and 11 months, respectively, after colectomy, 1 each for malignancy, stricture which prevented examination and profuse rectal discharge

If ileoproctostomy is not possible at the time of colectomy, the colon should be resected to as low a level as possible, with preservation of only a segment that can be removed later by a minor procedure The major portion of the rectum should be removed in all cases The hazard of malignancy is real, and continuation of the disease (11 years in 1 case) with

(9) Ann Surg 144 753 757 October 1956

its associated discomfort frequently requires later resection

► [This study of the fate of the rectal stump is significant, for in only 8 of the 45 patients was the stump clear of disease This points out the infrequency with which ileoproctostomy will be successful To obtain good results following ileoproctostomy requires extreme care in selection of patients —Ed]

Colectomy with Simultaneous Ileostomy as Surgical Treatment of Diffuse Ulcerative Colitis is discussed by Rupert B Turnbull, Jr [1] (Cleveland Clinic) In universal colitis, colectomy with simultaneous ileostomy is indicated when other management fails But primary colectomy is particularly urgent in toxic disease or when any other state of emergency exists, such as hemorrhage or perforation There is no way to "build up" such a patient except by promptly removing the diseased part

The medical (antibiotic) treatment of ulcerative colitis results in marked depression of the colonic flora Patients are long in hospital residence and have low resistance and altered bacterial antagonisms, therefore, they are particularly susceptible to postoperative staphylococcic enteritis Any significant growth of coagulase-positive staphylococci may help the surgeon to anticipate a postoperative enteritis Signs of onset of staphylococcic enteritis occur between the 2d and 7th days and are fairly constant, with abdominal distention (ileus), pain or cramps and almost concomitant tachycardia

Blood loss is minimal when subtotal colectomy with ileostomy is done in one stage However, it is imperative to add at least 1,000 cc whole blood to the circulating volume of these depleted patients in the several hours just preceding surgery Another hazard in the toxic patient is the lowered albumin fraction of the plasma proteins

Practically every patient coming to surgery has been treated with steroid drugs Withdrawal during a period of stress may result in fatal collapse A good plan to follow is to give 100 mg cortisone in the immediate preoperative hours, 100 mg Cortef® (soluble) intravenously during colectomy and 100 mg cortisone in the few hours after surgery and thereafter 50 mg cortisone every 6 hours for 24-48 hours

TECHNIC —Removal of the colon during the chronic intractable phase of the disease is relatively simple If the disease is not too

(1) Surgery 41 843 856 May 1957

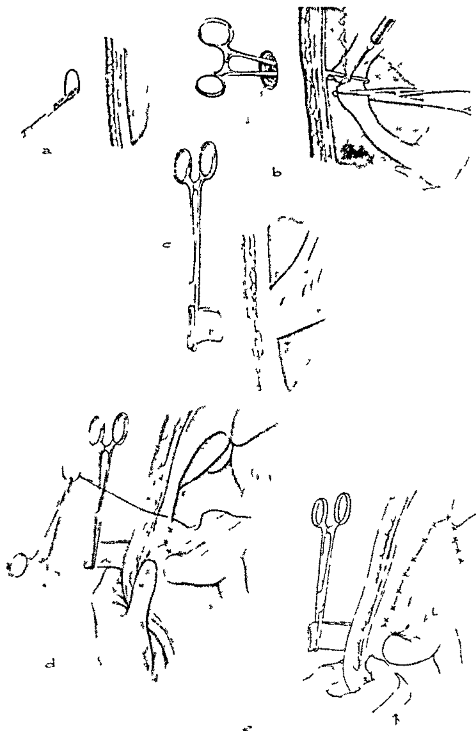


Fig 97 Method of ileostomy (Courtesy of Turnbull R B Jr Surgery 41 843 856 May 1957 from S Clin North America 36 841 1956)

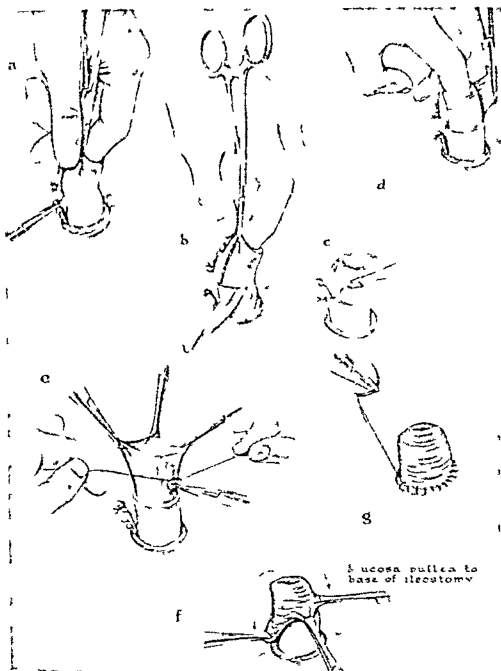


Fig 98—Preparation of mucosal graft (Courtesy of Turnbull R B, Jr Surgery 41 843 856 May 1957 from S Clin North America 36 841 1956)

acute, the rectum may be removed with the colon and with minimal blood loss by simply pulling the anus up through the levators until the perianal skin can be cut across Dissection is kept directly on the rectal muscularis and the levators are gently pushed off the rectum on all sides Because of loss of body fat stores, the ischiorectal fat

spaces are soft and mobile allowing the anus and perianal skin to be pulled into the pelvis Thus the entire proctocolectomy may be done through a relatively short left paramedian incision while ileostomy is made through a stab wound in a previously selected site on the right side of the abdomen Reperitonealization of the gutters is not necessary

Often the disease is acute and the colon not only is dilated to the extreme but the splenic flexure is thrust higher than normal The initial incision should extend up from the pubis to the umbilicus at which point it is carried diagonally across the left upper abdomen to the lateralmost costal margin Even with this exposure the colon may be unattainable because of its extreme friability and dilatation There is almost no peritoneal cavity to work in because in dilating the colon expands into the leaves of its mesentery thus seriously reducing its mobility The situation may be obviated by gently passing under direct vision and with the abdomen open 2 no 36 rectal tubes (attached in tandem) up from below into the descending colon Intermittent suction will rapidly empty the left side of liquid and gas while gentle manual pressure on the cecum and right colon will result in partial collapse of this side of the organ Not only is exposure enhanced but the colon contracts as it is deflated and its walls thicken with less danger of rupture and spillage Because of the extreme inflammatory reaction around the colon other organs may be intimately attached and appear inseparable Mobilization of the colon must be done with great care to prevent rupture The best plan is to incise the lateral reflexion of peritoneum as close to the bowel as possible and to shell the colon out of its mesentery The transverse colon and splenic flexure particularly may be dealt with in this way If fecal spillage occurs peritonealization of the gutters is absolutely contraindicated

Every effort must be made for the wasted patient to have a physiologically correct ileostomy at time of colectomy Figures 97 and 98 show the technic After attachment of the mesentery to the parietal peritoneum the abdomen is closed with steel wire The distal ileostomy is demuscularized and the resultant mucososubmucosal remnant is pulled down over the ileostomy and sutured to the skin

Universal colitis necessitated colectomy with simultaneous ileostomy in 123 patients 41 of these were in the acute toxic fulminant phase of the disease There were 6 deaths all in the toxic group

► [The eversion of ileal mucosa and its approximation to skin as described by Dr Turnbull significantly reduce the complications of ileostomy In many cases simple eversion is satisfactory without excision of the serosal and muscular layers —Ed]

Catastrophic Complications of Ulcerative Colitis Cancer Perforation and Massive Bleeding are discussed by Robert T

Tidrick and Robert C Hickey[2] (State Univ of Iowa) The term ulcerative colitis is used to denote disorders of the alimentary tract in which widespread ulceration of the colon predominates, and in which known specific causes have been excluded Patients were included having associated lesions of the terminal ileum and those having the segmental form, typically with involvement of the sigmoid and upper rectum

The incidence of colon cancer as a complication of this disease is not definitely known In 6 patients presented by the authors, ulcerative colitis began in childhood or young adulthood The disease was relatively protracted Activity was generally continuous without complete remission, and the degree of colitis was far advanced These observations indicate the need for objective reappraisal of patients with onset of ulcerative colitis in childhood or in early adulthood and in whom unmistakable activity continues

Perforation is most likely to be a complication of severe, rapidly advancing ulcerative colitis It is somewhat less likely in long-standing cases if there is dense fibrosis of the colonic wall There may be rapid progression to death from peritonitis or walling off and consequent obstruction or perforation into a neighboring viscus or development of fecal fistula Signs and symptoms of free perforation may be present, though little evidence of it is found at laparotomy In acute perforation, exteriorization of the area by colonic resection and establishment of ileostomy is indicated If there appears to be a walling off, the preferable procedure is ileostomy with later resection of the colon Bleeding is usually diffuse Rarely is any localized site found, except in the instance of bleeding neoplasm Resection may be necessary on an emergent basis and it must encompass all the area involved in active bleeding Administration of ACTH or cortisone may help cause perforation and/or bleeding

Significance of Diverticula of Colon in Massive Melena Massive melena without hematemesis is often challenging diagnostically Diverticula of the colon demonstrated in such cases are often overlooked as the source of bleeding Clinicians and pathologists have been reluctant to accept diverticula as the source of hemorrhage because a bleeding point

(2) J Iowa M Soc 46 485-492 September, 1956

may be difficult to find at autopsy Luther M Keith Jr and Jerome M Rim[3] (Ohio State Univ) surveyed 317 unselected patients with diverticula of the colon

The incidence of diverticulosis of the colon is estimated at 5-10% of adults over age 40 If hemorrhage from the colon is due to diverticula it should occur fairly often Specific criteria should be fulfilled before melena is attributed to diverticula bright red rectal bleeding without hematemesis, demonstration of diverticula and exclusion of any other potentially bleeding lesion, a negative upper gastrointestinal series and normal blood coagulation

Of the 317 patients, 60 (19%) had massive hemorrhage gross bleeding or stools repeatedly positive for occult blood by the guaiac test Of 19 (6%) with massive hemorrhage, all had rectal bleeding and 13 had syncope or subjective symptoms of shock Admission hemoglobin was 9 Gm /100 ml or below in 9 patients and fell to this level during hospitalization in 6 others The lowest recorded hemoglobin was 6 Gm /100 ml An average of 2,100 cc blood was transfused Conservative management was used in all cases adequate blood replacement and administration of a nonabsorbable antibiotic

Surgical resection is inadvisable in most patients because the diverticula are distributed over most of the colon and the specific bleeding site is seldom located It diverticula are limited to the left colon resection should be feasible, but if they are distributed over the entire colon, a transverse colostomy may help localize the site of hemorrhage, and hemicolectomy may suffice Emergency resection carries a high mortality All patients treated conservatively in this series survived Urgent surgical intervention is probably not advisable except in unusual cases

Diverticulosis and Diverticulitis of Colon is a disease of adulthood that appears more often as age develops About two thirds of persons aged 85 are so affected With increasing life expectancy more cases will be observed About two thirds of these patients have minimal or no symptoms The remaining one third have diverticulitis sufficiently severe to warrant or demand surgical treatment Arthur W Allen and

(3) A M A Arch Surg 74 571 573 April 1957

Glenn E Behringer[4] (Massachusetts Gen'l Hosp) report on 210 consecutive patients treated by resection since 1942 Of these patients 27 6% were admitted and operated on after their first attack of diverticulitis

The younger the patient with this disease, the more logical radical treatment becomes Their life expectancy is long, and if the disease is untreated, one of the serious complications (urinary fistula, abscess or frequent bouts of acute inflammation) will develop Most patients in this age group can have a one stage operation if so treated as soon as urinary symptoms occur, or severe inflammation takes place Nearly all patients of any age can be treated by resection if the definitive procedure is staged when indicated Immediate resection should not be done for fulminating inflammation, large abscess or acute obstruction Many persons with longstanding diverticulitis become chronically obstructed They can be safely relieved by well-planned resection, usually at an elective time

Diverticulosis and Diverticulitis of Colon is discussed by M M Zinninger[5] (Univ of Cincinnati) Diverticular disease of the colon may present itself by bleeding, intestinal obstruction, acute inflammatory episodes or the appearance of various fistulous communications In the past, resection of areas of diverticulosis and diverticulitis has been relatively hazardous With modern methods and appropriate antibiotic therapy, the danger has been so reduced that patients with chronic low-grade obstruction and low-grade or recurrent inflammation should not be denied the benefits of surgical excision of the involved segment of bowel

Operative removal often is more difficult than in cases of neoplasm The mesentery of the bowel is frequently thickened, shortened and fibrotic, and the ureter often is drawn up into it, so that accurate and careful dissection is essential, with early and satisfactory demonstration of the ureter be fore any resection of mesentery If acute or subacute infection or significant obstruction is present, preliminary diverting colostomy should be established before resection is attempted In acute perforation, local drainage plus proximal

(4) Pennsylvania M J 59 1345 1350 November, 1956
(5) Am Surgeon 22 683 695 August 1956

colostomy should be done, to be followed later by whatever measures seem appropriate for the given case. Simultaneous presence of diverticula or of diverticulitis and neoplasm is reasonably common; differentiation at times may be exceedingly difficult. The problem occurs as a rule only in patients in whom inflammation and at least some degree of obstruction are present. Usually, a preliminary diverting colostomy is required before safe resection is possible. The time between colostomy and resection should be considerably shorter than that deemed desirable in the past for inflammatory disease alone. With modern methods of surgery, 4-6 weeks is usually satisfactory.

Changing Concepts in Treatment of Diverticulitis of Sigmoid are discussed by John M. Waugh and Alexander J. Walt[6] (Mayo Clinic and Found.). Primary treatment of diverticulitis is medical and is based on bed rest, a bland low residue diet, regulation of bowel movements and use of broad spectrum antibiotics. With this regimen about 80% of patients should avoid operation.

When disease does not respond adequately to these measures the involved area must be resected. Ideally, this should be done when the disease is quiescent. If there are no complications, the single stage operation can be performed. Proximal colostomy is no longer regarded as a routine concomitant of the surgical treatment. A preliminary transverse colostomy will always be necessary in some patients. In others addition of a proximal colostomy at the time of anastomosis may be lifesaving.

The main indications for elective operation today are (1) intractability with recurrent episodes of inflammatory difficulties, (2) subacute obstruction, (3) walled off perforation which responds temporarily to antibiotics and nonsurgical treatment, (4) unexplained melena with x-ray evidence of diverticulitis, (5) a fistula between the sigmoid and other organs including the skin, (6) recurrent or persistent urinary symptoms caused by the diverticulitis and (7) persistence of a palpable mass or deformity from which malignancy cannot definitely be excluded.

(6) Journal Lancet 76 373-375, December 1956.

Surgical Management of Diverticulitis Bentley P cock[7] (Lahey Clinic) reviewed data on 40 patients who *surgery for diverticulitis Perforation, fistula formation* obstruction make diverticulitis a serious and sometimes disease Treatment of these complications involves repe hospitalization, multiple operative procedures and prolo medical and nursing care Morbidity and mortality ca reduced if patients are operated on before such complicat develop Surgery should be considered for any patient diverticulitis who has recurrent or persistent symptom

Diverticulitis of the sigmoid colon may closely simi *carcinoma of the rectum The presence of carcinoma o* sigmoid must be ruled out by the type and duration of sy toms and the findings on barium enema examination laparotomy The need for excluding carcinoma has a d bearing on the surgical management of the patient

Technic —A proximal colostomy is established in all patients complete obstruction, perforation or a fistula The colostomy is p in the proximal portion of the transverse colon so as not to inte with mobilization of the splenic flexure at resection The bow completely divided, whether it is exteriorized simply as a loop c tomy or as a double barrel Mikulicz spur If an abscess is in th lower quadrant, it is incised and drained at the same time U the patient is a poor operative risk, colostomy always is followe resection of the sigmoid colon Recurrence of symptoms is like follow closure of the colostomy without resection

If carcinoma is excluded, resection of the involved sigmoid is carried out within 3 6 months after colostomy, when acute in matory reaction will have subsided The resection then can be ca out with minimal morbidity and mortality If malignancy is no cluded, the involved colon must be resected within 2-3 weeks colostomy At this time, most of the inflammation will be presen the left ureter and bladder may be firmly adherent to the inflamm mass

Patients in whom complete obstruction, perforation or a fistul not developed are operated on by a one-stage resection with pri anastomosis The type of resection depends on whether the lesi benign or malignant If the diagnosis is diverticulitis, the bowe its mesentery are resected to preserve the superior hemorrhoid tery If the lesion is malignant, resection of the mesentery shoul clude the inferior mesenteric and superior hemorrhoidal arterie spite the associated inflammatory reaction Malignancy shoul excluded before the mesentery of the bowel is divided

In this series, there were no hospital deaths All 5 patie

with complications had had a primary one-stage resection of the diseased colon, all had had symptoms of diverticulitis for years

Definitive Radical Resection of Large Bowel for Recurrent Diverticulitis is advocated by George H Yeager[8] (University Hosp, Baltimore) Diverticulosis denotes uncomplicated diverticula in the intestinal tract, usually in the sigmoid colon They are primary acquired out pouches or herniations of the mucous membrane through gaps in the muscularis of the colon Most diverticula are clinically unimportant They are present in 5 10% of persons over age 40 In some, the condition produces mild symptoms such as disordered action of the bowel, intermittent flatulence and abdominal distention

About one fifth of patients develop such clinical evidence of inflammation that diagnosis of diverticulitis is justified If pain is prominent, especially if accompanied by marked physical signs, diverticulitis should be the diagnosis Most diverticulitis is mild and responds to conservative therapy Occasionally, an attack may be fulminating, with severe abdominal pain, high fever, leukocytosis and signs of spreading peritonitis, which requires immediate, emergency surgery Surgical intervention is now safe, and delay until grave complications occur is no longer justified Patients with a clear cut diagnosis of uncomplicated diverticulitis supported by a history of recurrent attacks and x rays, are suitable for primary sigmoid resection and anastomosis after a second major attack By selection of a period of quiescence, surgical hazards are reduced

► [These opinions represent a changing attitude toward the management of diverticulitis Mortality and morbidity rates following elective resection of the properly prepared not acutely inflamed colon are low enough to warrant more aggressive attack on this disabling disease —Ed]

Colonic Diverticulitis Associated with Carcinoma Review of 50 Cases Charles W Mayo and Leo T Delaney Jr[9] (Mayo Clinic and Found) reviewed 35 men and 15 women aged 41-82, who had diverticulitis and carcinoma of the colon at the same time and who underwent surgical treatment Pain was the most frequent symptom, occurring in 38% Other

(8) Am Surgeon 22 611 614 July 1956
(9) A M A Arch Surg 72 957 961 June 1956

symptoms were fever, nausea, weight loss or decrease in caliber of stools In 17 patients, previous episodes of diverticulitis had probably occurred Preoperative diagnosis or operative impression at the first stage of surgical treatment was correctly surmised in 38 patients Average time from onset of symptoms until initial surgery was 6 months in 46 patients Site of diverticulitis was in the sigmoid region in 90% Hospital mortality rate was 6% On the basis of a 98% follow up, over all 5 year survival rate was 50% Nine of the 50 tumors were grade 1 adenocarcinomas occurring in adenomas Such lesions are the most favorable of all surgically treated carcinomas of the colon If these lesions are excluded from the series, the absolute 5 year survival rate is 39%

Surgical Procedures for Cancer of Colon and Rectum Thaddeus A Krolicki[1] (Providence, R I) considers surgical intervention the treatment of choice in cancer of the colon and rectum Radical resection, if possible, is the accepted procedure The specific surgical approach depends on the patient's physiologic age and general condition, operative facilities, the training of the surgeon and his opinions on conservative versus radical surgery

Many operations are used for colon and rectum cancer Hartmann's anterior resection or sigmoidectomy with permanent abdominal colostomy closes the rectal stump and leaves it below the peritonealized floor Miles's abdominoperineal resection is the only one in which the dangerous tissues of the three zones of extramural lymphatic chains can be removed It is a radical resection in one stage and has a lower mortality and a higher curability rate than many other operations Mikulicz's partial resection of the colon using the extraperitonealized colonic loop requires staging, involves a temporary colostomy and is not radical enough It is useful for obstructive resection, but primary resection with end to end anastomosis is the procedure of choice Jones's two stage abdominoperineal resection with colostomy has the disadvantages of prolonged convalescence and double-barreled colostomy The Lahey two-stage abdominoperineal resection with permanent colostomy requires two operations The Turner-Rankin perineoabdominal resection is a two-

(1) Connecticut M J 20 709 714 September, 1956

stage procedure with permanent colostomy, but needs two operations Devine's radical perineoabdominal rectosigmoid resection in a functioning bowel can be performed by two surgical teams at the same time and the entire sigmoid can be removed Babcock's and Bacon's operations, with preservation of the sphincters, eliminates the colostomy and allows a perineal anus Often, however, continence is not preserved

When radical surgery is impossible because of metastases or poor general condition of the patient, a colostomy, side-tracking colocolostomy, fulguration or irradiation can be tried Hartmann's anterior resection or sigmoidectomy with permanent abdominal colostomy may be preferred in certain malignant lesions in the rectosigmoid or low sigmoid area in which insurmountable technical difficulties or the condition of the patient makes it inadvisable to attempt to re-establish bowel continuity Early diagnosis of large bowel carcinoma will lead to earlier surgery and more cures

Surgical Treatment of Familial Polyposis of Colon is discussed by H E Lockhart-Mummery, Cuthbert E Dukes and H J R Bussey[2] (St Mark's Hosp, London) Familial intestinal polyposis is a rare hereditary disease characterized by development in childhood or early adult life of many adenomatous tumors within the mucosa of the colon and rectum St Mark's Hospital has records of 58 families in which this disease occurred In each family case, the affected members were investigated, as many relatives as possible were traced and a family pedigree was prepared These 58 families include 1,069 persons, among whom 218 are known to have had polyposis, in 154, intestinal cancer developed

Major surgery was performed on 60 patients The most frequent method was removal of the colon with preservation of the lower rectum, to which the ileum was joined The anastomosis usually was made 10-12 cm from the anal verge This site, usually just below the sacral promontory, allows easy anastomosis and good rectal function, with an accessible rectal segment Preservation of the rectum by ileorectal anastomosis involves a risk that a fresh carcinoma may form later in the remaining rectal segment To reduce this possibility,

(2) Brit J Surg 43 476 481 March 1956

the patient must be kept under supervision for the rest of his life so that any benign polyps that may form may be destroyed before a malignant change occurs Under adequate supervision, the risk of carcinoma arising is probably small, it happened to 1 of 27 such patients, all of whom are still living

Because ileostomy has its own special complications, the authors feel the safer procedure is to rely on ileorectal anastomosis and to retain the rectal segment where possible

Since cancer development under age 18 is rare, the best period for surgery would be in the patient's teens, because then risk of cancer is still minimal

In patients over age 25 in whom large, congested polyps are seen, immediate surgery is suggested Since exfoliated cancer cells may implant from above on a raw surface and on granulation tissue it would seem unwise to fulgurate the polyps in the rectum before colectomy, unless the possibility of a carcinoma more proximally has been excluded with reasonable certainty

Polyposis of Colon C Thomas Flotte, Frederick C O'Dell, Jr, and Frederick A Coller[3] (Univ of Michigan) state that polyposis of the colon is a rare familial disease in which cells of the mucosa in the large intestine have an inherited tendency to proliferate and develop polyps These polyps tend to undergo malignant degeneration, resulting in adenocarcinoma of the colon or rectum while the *patient is relatively young* The polyps are true polyps or adenomas, each having a stalk derived from the submucous fibrous tissue and covered by an epithelial layer continuous with that of the bowel They occur by the hundreds, from the anus to the cecum (Fig 99), and may vary in size from bare visibility to several centimeters in diameter

Polyposis begins by a change or mutation in the genes of someone who does not have the disease, but who passes the mutant gene to the descendants The disease occurs in and is transmitted by both sexes In most cases, it is transmitted as a mendelian *dominant and only occasionally* as a recessive The polyps are not present at birth, but occur at or about puberty Common symptoms include abdominal discomfort,

(3) Ann Surg 144 165 169 August 1956

cramps diarrhea, bloody stools, anemia, weakness and weight loss Intestinal obstruction may occur The only good treatment is total colectomy, including the rectum, and establishment of a permanent abdominal ileostomy Subtotal colectomy with preservation of the rectum should be done only if the polyps in the rectum are completely removed, there is



Fig 99—Pathologic specimen of multiple polyposis (Courtesy of Flotte C. T *et al* Ann Surg 144 165 169 August 1956)

no carcinoma in the rectum or rectosigmoid and the patient is willing to have periodic sigmoidoscopies

Of 63 patients with polyposis of the colon seen in the past 20 years, 62% were males and average age was 33 7 years Polyposis was present in relatives of 54% of the patients and 12 7% had a family history suggestive of the disease Patients had symptoms of diarrhea, abdominal cramps and blood in the stools, present for a few months to 22 years Diagnosis was made by sigmoidoscopy and barium enema Operation was refused by 14, and 2 of these are known dead of colon carcinoma Advanced carcinoma was found in 9 when first seen Total colectomy with establishment of a permanent ileostomy was done in 15, and carcinoma was

found in 10 at surgery Recurrent carcinoma occurred in 4 patients, who have since died Average survival for 8 patients was 4 25 years Subtotal colectomy was performed in 25 patients, and 10 had carcinoma of the colon at operation. Recurrence of carcinoma caused death in 4 Carcinoma of the rectal sigmoid subsequently developed in 4 patients, 2, 6, 7 and 11 years after subtotal colectomy Periodic sigmoidoscopy with removal and fulguration of recurrent polyps was being carried out in the 11 patients who had survived an average of 7 years after subtotal colectomy.

Gracilis Muscle Transplant for Rectal Incontinence. Kenneth Pickrell, Nicholas Georgiade, Carter Maguire and Hugh

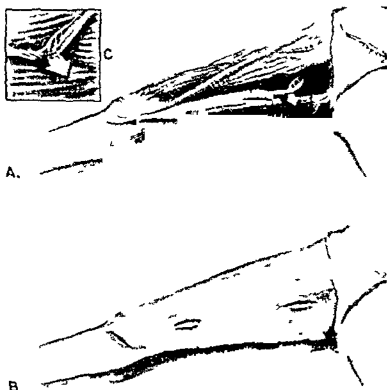


Fig 100.—A the gracilis originates just medial to the adductor longus tendon It arises from the lower half of the symphysis and pubic arch extends below the knee and inserts into the tibia in a dovetail *B*, the highest thigh incision is made *just medial* to the adductor longus tendon in the adductor gracilis groove The proximal part of the tendon is mobilized with finger dissection to avoid injury *to the neurovascular* bundle which enters from the lateral side (*C*) A second incision is made parallel to the muscle over its lower one third Traction placed through the highest incision discloses *path of muscle* A third *incision is made obliquely along* the upper and med[illegible] eserve insertion of the gracilis into the periosteum [illegible] iected by subcutaneous tunnels through which the [illegible] on by (2d-4th lumbar *nerves*) *and blood* supply [illegible] cilis high on its lateral side as a neurovascular [illegible] oid injury to it (Courtesy of Pickrell, K, *et al*

Crawford[4] (Duke Univ.) performed gracilis transplant operations on 18 children and 16 adults. Except for 1, the children had been incontinent since birth because of imperforate anus, spina bifida, meningocele or some neurogenic malformation involving the rectum and perineum. The adults, aged

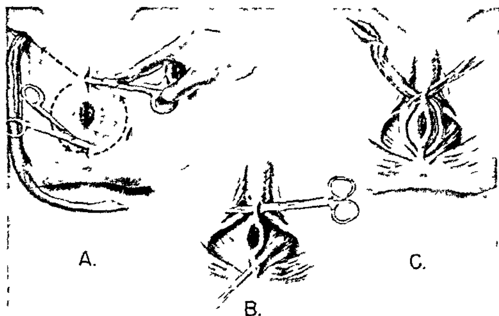


Fig 101—*A*, with absence of muscle tone and structural support, the perineal floor will bulge with patient in exaggerated lithotomy position Incisions are made in the anterior (12 o'clock) and posterior (6 o'clock) commissures, injury to raphes being avoided A subcutaneous tunnel is made around the anus Another tunnel is made to connect the highest incision in the thigh with the incision at 12 o'clock *B*, when possible, though not essential, pulleys are constructed from the anterior and posterior raphes *C*, the gracilis tendon and muscle are threaded through the tunnels and beneath pulleys, if constructed. (Courtesy of Pickrell, K., *et al* Surgery 40 349 363, August, 1956)

20-72, included 3 paraplegics, 2 with perineal colostomies and 11 who were incontinent after operations on the anus or rectum.

The gracilis muscle is ideally suited and readily adaptable for transplantation since it is the most superficial muscle on the medial aspect of the thigh and has a somatic nerve supply. The technic involves thigh and perianal incisions (Figs. 100-102). Although the tendinoperiosteal insertion of the gracilis may be anchored to the tuberosity of the ischium, the

(4) Surgery 40 349 363, August, 1956

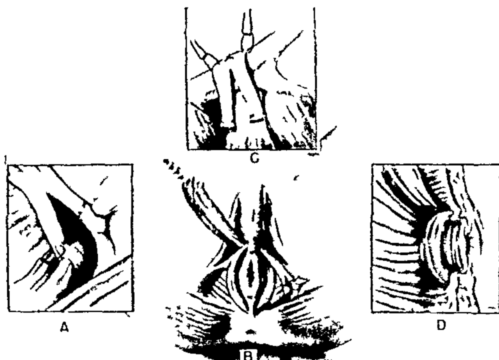


Fig 102—*A* and *B* the dovetail tendinoperiosteal insertion of the gracilis is split to form a Y If the gracilis is to be anchored into the tuberosity of the ischium on the opposite side an incision is made directly over the tuberosity at about 3 or 4 o clock One end is anchored around a pulley or periosteal flap elevated from the tuberosity The other limb of the dovetail is anchored around a pulley or bundle of levator ani muscle with silk sutures *C* in heavy patients the gracilis should be an chored to the adductor tendon or lacunar ligament A groin incision is made on the side opposite the transplant A subcutaneous tunnel connects it with the incision at 12 o clock The tendon is threaded through the tunnel and beneath the lacunar liga ment or adductor tendon on the c [illegible] and to the ligament on each side [illegible] closed by a collar of contractile [illegible] gracilis to make the orifice very [illegible] withstand considerable pressure [illegible] *363 August 1956*)

adductor tendon or the inguinal ligament on the opposite side, the point of choice in heavy persons is in the groin

Rectal continence was restored in all patients Two operations were necessary in 1 Optimum age for surgery is 4-5 years A similar operation was successful in 3 patients with urinary incontinence

Interparietal Hernia has a sac (usually in the inguinal region) which passes between the layers of the anterior abdominal wall. It may or may not be associated with or communicate with a sac in the common situation in the inguinal canal passing down into the scrotum with the spermatic cord. The sac may be unilocular or bilocular; the latter is more common. The commonest situation is between the internal and external oblique muscles of the abdomen. Less common locations are between the peritoneum and deep muscular layers or subcutaneously in the anterior abdominal wall or thigh.

According to Vernon Barling[5] (Sydney), in 90% of cases an intraparietal hernia presents itself with acute intestinal obstruction Pain is localized in the suprainguinal region. A lump is palpable only in interstitial and superficial hernias and not in properitoneal hernias. Abnormal positioning of the testis is frequent. Diagnosis may be difficult or impossible when no intestinal obstruction is present, when no lump is palpable or if the palpable lump contains encarcerated omentum, or when there are no testicular or scrotal abnormalities. Mortality is high in properitoneal hernias, particularly when obstruction persists after apparent reduction of an encarcerated inguinal or femoral hernia.

Properitoneal hernias are found and treated more readily if exploration of the inside of the sac and peritoneal cavity in relation to the inguinofemoral region is routine at every inguinal or femoral herniorrhaphy. For a strangulated interparietal hernia, a combined abdominoinguinal approach more readily exposes the site of obstruction.

Richter's Hernia is discussed by W. Milo Keynes[6] (Cambridge, England) In 1785, Richter described "small ruptures," meaning hernias, in which only part of the bowel wall was strangulated. These he had found mainly in the abdominal wall between the xiphisternum and the umbilicus

(5) Australian & New Zealand J. Surg 26:32-35, August, 1956
(6) Surg, Gynec & Obst 103 496-500, October, 1956

(as types of ventral hernias), though he also described inguinal and femoral hernial sacs He appreciated the true nature of the condition, described by Littre in 1700, as due to herniation of a preformed diverticulum of the bowel Treves, in 1887, collected 50 cases of Richter's hernia, or partial enterocele, and defined the condition as *strangulation of only a part of the circumference of the bowel wall in a hernial orifice* and different from strangulation of a preformed diverticulum in a hernia "The involved segment may rapidly pass into gangrene, and yet the lumen remain free" Most modern authors, agreeing with Treves, separate herniation of the congenital Meckel diverticulum, or Littre's hernia, from Richter s hernia

Richter's hernia may occur at any of the hernial sites, it may occur in the supernumerary sac of an interstitial hernia or in an incisional hernia It usually occurs with a relatively small hernial ring with firm margins The commoner sites are in the femoral and inguinal regions Most commonly the lower ileum is involved, but any part of the jejunum, ileum or colon may be affected Sometimes omentum is involved as well

The constricted portion of the intestine becomes distended and swollen and may retain its deformity some time after constriction is relieved, appearing as a diverticulum These changes in the constricted intestine are always secondary to onset of strangulation In Richter's hernia, the free border of the intestine opposite the mesentery becomes nipped The tumor is always small unless complicated Adhesions are un common, and the intestine is usually easy to reduce

Symptoms are similar to those of strangulation of the entire wall of the intestine Diagnosis may be difficult, particularly since perforation may occur without serious symptoms first developing Local signs may appear only with local gangrene of the intestinal wall, and this is especially true when only a small amount of the circumference is nipped The initial partial obstruction may become complete through further protrusion, increased kinking or local edema, owing to delay in diagnosis and treatment

Mild degrees of Richter's hernia present with localized pain or discomfort with an epigastric sensation of pulling or

tugging. There is some constipation. If obstruction is complete, distention, increased bowel sounds and colic are present Local signs may be absent; when present, they are frequently misinterpreted. X-rays have been disappointing in diagnosis.

Early operation is necessary without preliminary attempts at reduction. Resection of the intestine may be necessary, but small areas of gangrene may be buried by invaginating sutures The authors report 3 cases of Richter's hernia occurring in an incisional hernia. One internal Richter's hernia was in the supravesical fossa.

Operative Management of Sliding Hernia. According to Jerome Giuseffi and H. Thomas McSwain[7] (Cincinnati), the *problem in management of this condition arises from the* presence of an intra-abdominal viscus whose anterior serosal

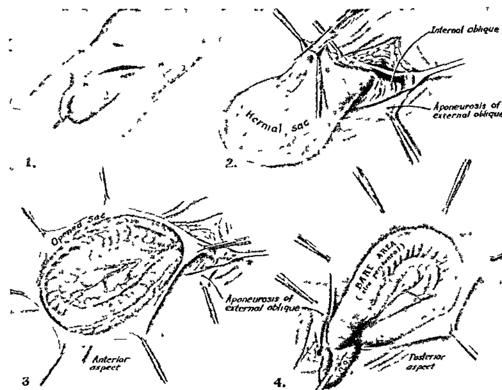


Fig 103 —Step *1* usual hernioplasty incision Step *2* entire hernial sac has been freed from adjacent tissue and opened anteriorly *Step 3,* with anterior wall of sac open, sliding hernia of sigmoid is seen Peritoneum of posterior wall is serosa of sigmoid loop Step *4* posteriorly sigmoid colon is bare and free from peritoneal covering (Courtesy of Giuseffi J, and McSwain, H T Surg, Gynec & Obst 104 425-432, April, 1957)

(7) Surg, Gynec & Obst 104 425 432 April, 1957

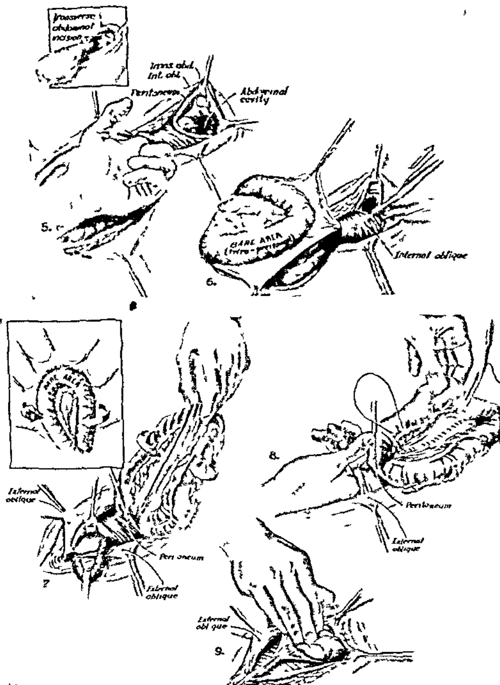


Fig 104 (top) —Step 5, finger can be passed through neck of sac, showing continuity of sac and peritoneal cavity Step 6 inversion is begun by passing Kelley clamp through muscle-splitting incision (see inset) and through neck of sac By grasping apex of hernial sac, reduction into peritoneal cavity is begun

Fig 105 (bottom) —Step 7, sac has been reduced into abdomen and through muscle splitting incision for mechanically facilitating resuture of inverted sac Inset shows cond[illegible]

[illegible] is reduced within abdomen and muscle splitting incision is closed.

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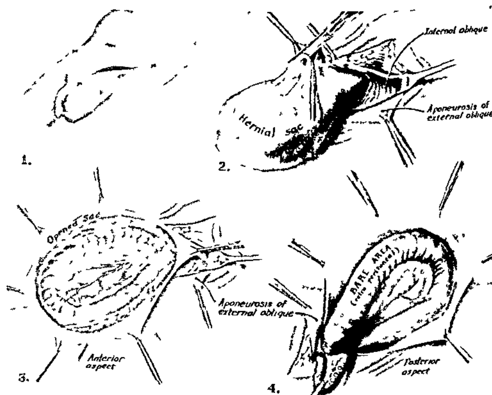


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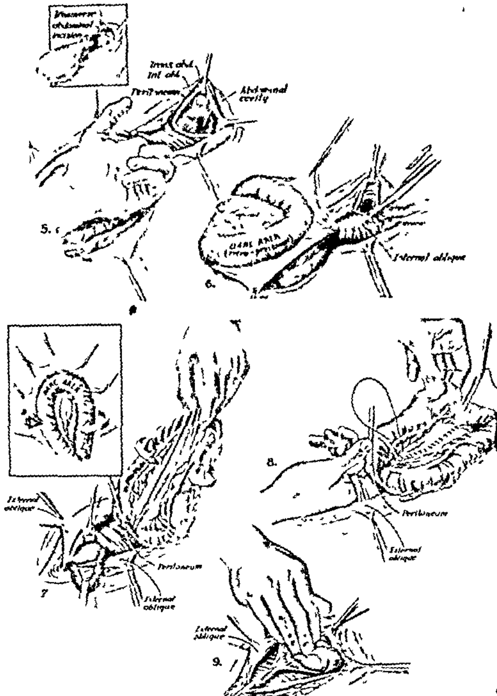


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Fig 105 (bottom) —Step 7 sac has been reduced into abdomen and through mus- … Inset shows … free anterior … l from lateral … line to complete inversion, thus forming anterior layer of new free-swinging mesentery. Step 9, bowel is reduced within abdomen and muscle-splitting incision is closed

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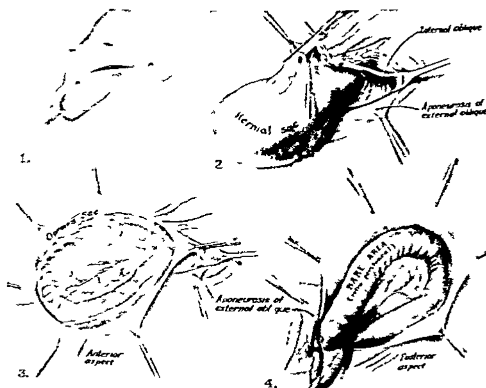


Fig. 103.—Step 1, usual herniotomy incision. Step 2, entire hernial sac has been freed from adjacent tissue and opened anteriorly. Step 3, with anterior wall of sac open, sliding hernia of sigmoid is seen. Peritoneum of posterior wall is serosa of sigmoid loop. Step 4, posteriorly sigmoid colon is bare and free from peritoneal cover. (Courtesy of Giuseffi, J., and McSwain, H. T.: Surg., Gynec. & Obst. 104:425, 1957.)

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protruded After the sac has been disposed of, the hernia may be repaired simply by closing the opening in the transversalis fascia snugly around the cord This is best done if the cord is lifted from its bed, so that the entire floor of the inguinal canal can be inspected Concurrently, any direct or femoral hernia can be detected *Undoubtedly, many hernias* can be cured simply by closing the hole in the transversalis fascia, but some may require further plastic repair

The relaxation incision in the sheath of the rectus muscle is a valuable adjunct to any form of plastic repair and provides relaxation of the tissues otherwise unobtainable The author uses it almost routinely in repair of inguinal hernias in adults Such an incision will not weaken the abdominal wall if it is properly placed and as far mesial as the attachment of the aponeurosis of the external oblique to the rectus sheath will permit The author transplants the spermatic cord almost routinely in adults into the original Halsted subcutaneous position This allows tight and complete closure of the lower end of the canal and better prevents a direct recurrence than if the cord is left in the Ferguson or Bassini positions It is highly important to reduce the size of the cord so that the internal ring may be closed snugly around as little tissue as possible Large cords can be made much smaller by removal of the cremaster and any fatty tissue or lipomas that may be in the cord Structures around the internal ring should be closed tightly enough to prevent a new hernia sac from obtruding itself between these structures and the cord

Tantalum gauze has proved most useful in patients with tissue deficiencies or extremely weak tissues It has the advantage over fascia flaps of not giving trouble in the presence of infection Silk and cotton are the best suture materials in all clean surgical cases Catgut should never be used as a suture material in hernia repairs

► [The extremely low recurrence rate reported by Dr Koontz reflects his extensive experience and thoughtful approach to this problem —Ed]

Five-Year Results in Treatment of Inguinal Hernia W L Estes, Jr[9] (Bethlehem, Pa) states that Cooper's ligament repair has a definite place and probably is the operation of choice in the repair of inguinal hernias

(9) Am Surgeon 22 948 963 October 1956

layer forms in part the posterior portion of the hernial sac Because of this anatomic arrangement, the usual treatment of the hernial sac, i e, excision and high ligation, is impossible The sac, however, can be eliminated by inversion, which reverses its direction Instead of projecting inferiorly, the sac now projects superiorly into the abdomen Further by this inversion the anterior peritoneum of the hernia is used to form an anterior peritoneal layer for a new mesentery which now suspends the previously amesenteric bowel freely within the abdomen Elimination of the sac takes place by its conversion into a mesentery and by the fact that inversion places raw areolar surface to raw areolar surface, allowing *the empty space (inverted sac) to obliterate rapidly by fusion*

The inversion method (LaRoque) fulfills all requirements for adequate and complete obliteration of the sac and provides easy restoration of the sliding viscus to the normal abdominal confines (Figs 103 105) The technic may be confusing on first attempt, but once mastered, even the most extensive and complicated sliding hernia can be managed simply and rapidly

Personal Technic and Results in Inguinal Hernia Repair In 436 patients who had operation for inguinal hernia Amos R Koontz[8] (Johns Hopkins Univ) reports a recurrence rate of 0 46% This almost 100% cure rate is possible if surgeons are willing to vary any of the many operations to fit the anatomy of their patients

It is axiomatic that in indirect inguinal hernias there should be a high ligation of the sac Simple transfixion and ligation is readily done in primary indirect inguinal hernias where the neck of the sac is narrow However, in large indirect inguinal hernias and especially in recurrent hernias the base of the sac is often broad, and simple transfixion and ligation cannot be done In these cases, the sac should be dissected free and excised and the peritoneum closed with a running suture of silk or cotton The LaRoque incision is often most valuable in dealing with the sac

In indirect inguinal hernias, the floor of the inguinal canal is often strong (especially in young patients), except for the opening in the transversalis fascia through which the sac

(8) J A M A 164 29 36 May 4 1957

protruded After the sac has been disposed of, the hernia may be repaired simply by closing the opening in the transversalis fascia snugly around the cord This is best done if the cord is lifted from its bed, so that the entire floor of the inguinal canal can be inspected Concurrently, any direct or femoral hernia can be detected Undoubtedly, many hernias can be cured simply by closing the hole in the transversalis fascia, but some may require further plastic repair

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TECHNIC —A skin incision is made 1½-2 cm medial and parallel to the inguinal ligament The lower end should expose the pubic tubercle The external oblique is divided in the line of its fibers at the middle of the bulge of the inguinal canal The medial leaf of the external oblique is freed bluntly from the cord, the internal oblique and the rectus muscle up to its fusion with the internal oblique to form the medial half of the anterior rectus sheath The lateral leaf of the external oblique is freed from the cord down to and exposing the inguinal ligament The cord is raised and any direct hernia is recognized The cord is freed from all muscle or areolar attachment up to the internal ring The peritoneum can be identified near the neck of any indirect sac The sac is incised and explored The lower abdomen and femoral canal are palpated, any concomitant femoral hernia is corrected The sac is freed from the cord by traction and sharp dissection, ligated high at its neck and resected If a direct hernia is present with an indirect, by traction on the neck of the sac, a pantaloon type of double hernia protrusion can be united into a single sac before resection

Repair of the inguinal canal is done by retracting the cord out of the wound laterally Any direct hernia is completely freed, restored to the abdomen and the opening in the transversalis closed by suture Resection of a sac is rarely necessary in a direct hernia If the internal ring is large, it is closed by suture of its margins snugly around the cord The conjoined tendon (sharp lateral edge of the rectus sheath and muscle) is sutured to either the inguinal or Cooper's ligament, or this maneuver may be modified by splitting the rectus sheath about 1 cm medial to its lateral margin and suturing both the tendinous margin of the rectus muscle and the lateral leaf of its sheath to the inguinal or Cooper's ligament It is best to suture the tendinous margin of the rectus and its sheath to both Cooper's and the inguinal ligament using care that the femoral vessels are not injured When sutures in Cooper's ligament have been inserted and tied, this layer of sutures is completed in the lateral half of the canal by suturing the rectus sheath and muscle or conjoined tendon to the inguinal ligament up to the internal ring level The lateral leaf of the external oblique is sutured to the medial margin of the rectus sheath, overlapping the edges whenever possible The cord is dropped back into the wound on the new floor of the canal and the medial leaf of the external oblique sutured over the cord to the anterior surface of the inguinal ligament or the external oblique close to it, forming a new roof to the canal and a new external ring The wound is then closed

Of 363 patients followed for 5 years, 50% were aged 40 60 and 15% over 60 None were under 18 There was no postoperative mortality Of 230 with indirect hernia, 2 had a recurrence, 2 atrophy of the testis 1 hydrocele and 2 infection Of 113 with direct hernia, 2 had recurrence and 1 atrophy of the testis Of 20 recurrent hernias originally, 1 had another

recurrence and 1 a hydrocele All recurrent hernias were direct The causes of recurrence seemed to be tension on the suture lines and infection Of the 5 recurrences, 2 occurred within 1-2 years, 1 within 3 years, 1 within 3½ years and 1 patient was asymptomatic at the 5-year examination

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THE EXTREMITIES

Intermittent Claudication: II. Natural History is reviewed by J K Francis and A J Barnett[1] (Melbourne) because the value of any remedy for the disease can be assessed only against its natural history A statement that after a particular treatment a patient's walking distance has increased a certain amount means little unless the daily variation is known The best test of a patient's walking distance is normal walking, but the patient's statements on performance are often untrustworthy The step test has been devised to standardize the procedure and make it objective The patient walks over two steps, each 9 in high, until pain appears, three separate tests are performed in 1 day, approximately 5 minutes apart

Considerable variation was noted in different tests on the same day and from day to day in the same patient There was no evidence that walking distance, as measured by the step test, varied with the season Various therapy was studied intravenous saline intramuscular water and oral calcium lactate as control placebos intra-arterial vasodilators, intramuscular heparin and oral Roniacol® as active medication None of the active treatments were superior to placebos

The initial and final step test performances of 23 patients with claudication of various duration, followed by the step test for 12 months or longer, showed that about half the patients were improved and half unchanged None were worse Clinical studies over 2-5 years showed about half the patients to have the same subjective degree of claudication, about one-fourth were improved and one fourth worse Only 2 of 125 patients required amputation The incidence of clinical ath

(1) M J Australia 2 794 797 Nov 24 1956

erosclerosis in the heart and brain was high, about half the patients were thus affected by the end of 5 years' observation Survival was over 5 years from onset of claudication in half the patients and over 2 years in 80%

Treatment of intermittent claudication is not urgent Interference with the patient's way of life by the disability is the main indication for therapy Treatments previously advocated, vasodilator drugs and sympathectomy, are of no value Beside symptomatic measures to reduce the work of ischemic muscles, the only logical treatment is increase of the blood flow by vascular grafting if arteriograms show this is feasible The development of ischemia in the heart and brain though frequent, does not preclude operation

Does Buerger's Disease Exist? A study of 73 patients by A Mounier-Kuhn and P Wertheimer[2] questions the specificity of the disease as a clinical entity on the basis of histopathology, etiology and pathogenesis Hence they prefer the term "thromboangiosis" At the time of first symptoms, 87 7% of their patients (all men) were under age 45, 32 (44%) were natives of Central Europe, Italy, Asia Minor and North Africa, 68% were Jewish In 7, frozen feet or hands occurred from 6 months to 23 years before onset of the disease Three had a history of injury Among the patients were 11 soldiers seen during the war, 2 prisoners, 1 deportee and 1 seen after discharge from a military prison Another, stabilized for 5 years, had a serious relapse during the 1st month of the war Thus 16 (21 9%) could point to cold, malnutrition and repeated affective shock as the cause of their thromboangiosis These varied causes probably are associated with a single pathogenic mechanism sympathetic, endocrine, or neuroendocrine

There is no ideal treatment for thromboangiosis The authors achieved only inconsistent, temporary or unsatisfactory results with medical measures, and hence recommend surgical intervention Their 73 patients had 159 operations of which 49 were adrenalectomies, 2 bilateral Two others were done elsewhere All but 1 adrenalectomy were combined with lumbar sympathectomy, splanchnicectomy, or both Only 1 patient died after adrenalectomy, none had acute adrenal insufficiency Three had only splanchnicec-

(2) Lyon chir 53 194 208 Mar Apr 1957

tomy, 1 bilateral, 31 had splanchnicectomy and lumbar sympathectomy, usually after adrenalectomy on the opposite side High lumbar sympathectomy is preferable to low sympathectomy because of its better vasodilating effects Only 25 lumbar sympathectomies were performed alone

According to the authors' concept of pathogenesis, adrenalectomy is the only operation regarded as curative Sympathectomy has an immediate vasodilating effect, but this remains partial, local and palliative The effect of adrenalectomy is less prompt, but it extends to the entire vascular system and hence can prevent new thromboses Combined adrenalectomy and lumbar sympathectomy produce both effects in a single operation Stellate ganglionectomy provides excellent vasodilatation for the upper extremities and was used in 4 patients Four others with arm lesions had resections of the left 3d thoracic sympathetic ganglion

Direct intervention on arteries is rarely indicated in thromboangiosis because of multiple, often distal, thromboses Twelve periarterial sympathectomies (5 by other surgeons) gave no durable benefit Arteriectomy is excellent when only obliterated arterial segments are resected, if these are removed completely and collateral pathways are kept intact Of 14 arteriectomies, 11 were done on the superficial femoral and popliteal, 1 on the external iliac and common femoral and 2 on the radial Thrombectomy was done in only 4 patients, 1 attempt at removal of thrombus from the primary iliac, external iliac and common femoral could not prevent high amputation a year later Two of 3 arterial grafts involved the femoropopliteal segment and were failures One external iliac graft was successful

Surgical indications vary according to the stage at which the patient is seen In the pregangrenous stage, adrenalectomy is the basic procedure, on the predominantly affected side, combined with lumbar sympathectomy and eventually splanchnicectomy Sympathectomy and splanchnicectomy are done on the other side after 2 or 3 months The only indication for local intervention is localized thrombosis in a large proximal vessel, when an arterial graft may be useful

In the gangrenous stage, the patient wishes to save his extremity, but his first demand is pain relief If medical treatment and local care bring considerable improvement an

endocrine sympathetic operation should be attempted Often, however, intensity of pain and progression of gangrene necessitate immediate amputation If age and general state permit, adrenalectomy with lumbar sympathectomy should be proposed later, with the hope of conserving the remaining leg Forty-six amputations were done Amputation of toes may suffice if 1 tibial artery is still functioning If the foot or ankle is ulcerated, high amputation should be done Of 18 amputations of the foot at the ankle, only 6 healed, 12 were terminated by high amputation, either immediately or after a series of resections One patient with 4 resections of a lower extremity preferred primary amputation at the thigh on the 2d side

Four patients (5 5%) died after operation, 1 after a severe hemorrhage following adrenalectomy and 3 after thigh amputations The immediate results (first 6 months) were good or excellent in 53 4% and mediocre in 19 2%, and 21 9% were failures Sixty-one patients were followed 8 months to 20 years (average 4 years, 10 months), and 55 7% had good or excellent results, 26 2% were failures and results were fair in 18 1% The value of early surgical treatment was demonstrated 75% of patients operated on in the pregangrenous phase had good or excellent results, with no failures In the gangrenous stage, 55% represented failures or poor results Results according to type of operation were difficult to determine, since each patient usually had several operations However, endocrine interventions showed 56 60% satisfactory results, as against 37 5% for ganglionectomies alone

Value of Lumbar Sympathectomy in Intermittent Claudication is discussed by Josephus C Luke[3] (Royal Victoria Hosp, Montreal) Pain in the foot usually means main vessel occlusion below the knee, if in the calf, the occlusion is usually in the popliteal or femoral arteries or higher, in the thigh, the iliacs are involved, and in the low back and buttocks lower aortic occlusion is usually the cause

Intermittent claudication (usually calf) can resolve spontaneously with no treatment, probably because a short segmental occlusion may develop in the lower part of the femoral artery and be bypassed by an excellent collateral

(3) Surgery 41 165 171 January 1957

circulation The general consensus is that lumbar sympathectomy in the patient complaining only of pain on walking is not a worthwhile procedure

Arteriograms of 17 men, aged 42-67, complaining of calf claudication revealed good filling of the femoral artery down to the popliteal with abrupt termination and no evidence of filling of the main vessels below this level Collateral circulation extended distally only They were obviously not good candidates for arterial grafts and all were treated by lumbar sympathectomy with removal of the 1st, 2d and 3d lumbar ganglions The postoperative course was uneventful in all patients and the foot warmed markedly Postsympathectomy neuralgia was experienced by all Improvement in walking distance was threefold or more

Little or no improvement in walking distance occurred when sympathectomy was performed for patients whose level of occlusion was higher in the femoral artery The collateral circulation about the knee is the probable factor in the difference in results between the popliteal and femoral levels Fortunately, these higher obstructions are usually segmental in character and therefore suitable for the end to-side arterial bypass graft

Pain in Lower Limb after Sympathectomy is discussed by G D Tracy and F B Cockett[4] (St Thomas's Hosp, London) Among 51 lumbar sympathectomies in 42 patients, pain after operation was observed in 9 extremities (7 patients) The clinical features were remarkably similar in each of the 7 patients There was constantly a latent period until the 10th-17th postoperative day, when pain appeared Onset was sudden, the pain becoming severe and unremitting in some instances and always worse at night In each patient, the pain had an identical distribution to the anterior parts of the thigh down to the knee, and corresponding closely to the distribution of the 1st and 2d lumbar dermatomes The pain was associated with marked hyperesthesia, and relief was not obtained with aspirin and codeine Some patients had sleepless nights for as long as 3 weeks, after which the pain usually began to abate Physical examination revealed hyperesthesia to light touch in the affected areas, with cool, moist

(4) Lancet 1 12 14 Jan 5 1957

skin, but without sensory loss or other evidence of somatic nerve damage Spontaneous remission occurred in all but 1 patient, after 10-16 weeks

► [The occurrence of postsympathectomy pain can be a distressing complication The study reported here by Tracy and Cockett provides rather interesting observations, but unfortunately it does not elucidate the mechanism for the development of pain —Ed]

***Physiopathology and Sympathetic Therapy in Recent Cases of Freezing* Eight New Cases**, the first seen since the winter of 1939 40, are reported by J de Girardier and P Aupecle[5] (Dijon, France) Five patients had frozen hands with necrotic digital ulcers, one had undergone partial amputations for frozen fingers in 1940 Three had frozen feet with massive and extensive necrotic lesions Excellent results obtained in these patients and in 37 others previously reported furnish criteria and indications for various therapeutic methods

Procaine infiltrations of the sympathetic nerves constitute basic therapy in all patients, since their vasodilating effect provides maximum reversibility of circulatory disturbances In frozen extremities without necrotic lesions, this may be the only treatment necessary to effect a cure, especially if administered as emergency treatment immediately after the accident After the first injection, the pains cease or diminish notably and the edema recedes, then the phlyctenules dry up, ecchymotic spots and cyanosis disappear, and finally, the small superficial ulcers heal rapidly The increased oscillometric indexes show circulatory improvement Even when these infiltrations are not used immediately, they often produce remarkable benefit

In freezing accompanied by necrotic lesions, infitrations of sympathetic nerves should be used primarily as a therapeutic test Reversible lesions disappear and necrosis is definitely delimited In freezing with partial necroses (necrotic ulceration), infiltrations alone often suffice When there is more extensive loss of tissue, and cicatrization is slow, improvement in local circulation resulting from procaine infiltrations makes the area favorable for small dermoepidermal grafts If the necrotic lesions are extensive and massive, the infiltrations are not effective except in areas where vascular obliteration is not complete and ischemia is not total

(5) *Lyon chir* 52 300 310 1956

The number and timing of the infiltrations vary, depending on promptness of treatment and character of the lesions. Clinical effects and oscillometric curves furnish a guide for continuing therapy. Five or 6 infiltrations usually are necessary in patients without, or with partial, necrosis. In those with extensive necrosis, the infiltrations should be repeated as long as necessary, i.e., until direct intervention on the sympathetics, or until amputation, and even afterward. When both hands are frozen, stellate injections are administered one day on one side and one day on the other, whereas with frozen feet, lumbar sympathetics on both sides may be injected simultaneously, if necessary. Intra-arterial injections of procaine have not been used alone, but have occasionally been combined with lumbar injections.

If serious and extensive lesions are present, operation on the sympathetics should not be done immediately, or even early, because infiltrations often prove sufficient in themselves and always should be used as a fundamental test of the gravity of the process, and to indicate the optimum time for surgical intervention.

In patients without necrosis or with superficial necrosis rapidly cured by infiltrations, indications for sympathectomy appear relatively late, in case, despite infiltrations, residual vasomotor symptoms persist. Their extent and intensity determine the mode of sympathetic intervention, either on periarterial sympathetics or on the chain (high lumbar sympathectomy with ablation of the 1st ganglion for the lower extremity and substellar sympathectomy for the upper extremity). In patients with necrotic lesions, indications for sympathectomy occur oftener and present themselves earlier. If, after elimination of scabs, simple necrotic ulcers, especially in the feet, remain atonic and slow to heal despite procaine infiltrations, sympathectomy has rapid and cicatrizing effect, besides improving the local circulation. With extensive and massive necrosis, often seen in frozen feet, it is preferable to operate on the sympathetic chain as soon as necrosis is delimited, before amputation.

The method of intervention depends on the site, extent and intensity of the lesions, as well as the patient's age. In aged persons, the operation should often be limited to periarterial sympathectomy, while in younger and especially

middle aged persons, lumbar sympathectomy is preferable because of its more lasting effect and efficacy in counteracting arterial damage By the consequent stimulation of circulation, the limitation of lesions is stabilized and the tissues are in the best possible condition for minimum amputation, for vascularization of a graft and for avoidance of residual pain

Below-Knee Amputation in Arteriosclerotic Gangrene is discussed by R R Kendrick[6] In peripheral vascular disease and especially in arteriosclerotic gangrene, below-knee amputation offers many advantages over above knee amputation and can often be performed successfully

In a consecutive series of amputations of the lower limb for obliterative arterial disease, 51 were performed through the calf, of which 32 (63%) healed by first intention Three patients died, healing failed in 2 patients and above knee amputation was required In addition, massive necrosis occurred in one stump, which had been soundly healed for 18 months

Refrigeration anesthesia is considered valuable in a few patients in whom operative risk is great Gentleness and accuracy in suturing the skin flaps is important Formation of a hematoma is a serious complication Unless the wound is completely dry, drainage is preferred In arteriosclerotic gangrene of the foot requiring major amputation there are few contraindications to below-knee amputation This can nearly always be relied on to heal rapidly and well and provides an excellent stump for a prosthesis

Evaluation of Transmetatarsal Amputation in Patients with Diabetes Mellitus was made in two groups by Frank C Wheelock, Jr, John B McKittrick and Howard F Root[7] (New England Deaconess Hosp, Boston)

Group I included 67 patients who had transmetatarsal amputation for neuropathy or infection Only 5 late failures requiring reamputation occurred Twenty two patients are known to be dead of causes not related to the surgery, 29 are well and using the foot—many well beyond the 5 year period

Group II included 366 patients with arterial insufficiency, they were older and stayed longer in the hospital than group I patients In about one third, failure eventually resulted

(6) Brit. J Surg 44 13 17 July 1956
(7) Surgery 184 189 February 1957

Most failures occurred immediately after operation Incidence of failure was more closely related to evaluation of collateral circulation by venous filling time and by other means than to presence or absence of a popliteal pulse Only a few patients had pedal pulses Of those who lived 3 years, 61% had healed stumps at the end of that period, and of those who lived 5 years, 50%

Operative mortality in group II was low, but a large number of deaths within a few years indicates the poor general condition of these patients In 48, the opposite limb previously or subsequently had to be amputated Sympathectomy performed on 18 patients seemed to help little unless there were clinical signs of vasomotor activity, such as sweating or readily changing color or temperature levels When artery grafts were successful, transmetatarsal amputations were avoided Long-term survival of many of these amputees is gratifying Of patients with healing at the end of a year, only 21 had subsequent failures Several were trouble free for as long as 11 years

The authors conclude that transmetatarsal amputation has been sufficiently successful and durable to indicate its continued use in selected diabetic patients

Tendon Grafts in Injuries of Flexor Tendons in Fingers and Thumb: End Results in Consecutive Series of 74 Cases are presented by Gunnar Strandell[8] (St Gorans Hosp, Stockholm) All patients were treated with free tendon grafts There were 7 subcutaneous ruptures, the rest were open injuries The thumb was affected in 24 patients the fingers in 50 On the basis of the degree of fibrosis expected, having regard to the character and primary treatment of the injuries, the patients were preoperatively classed in 4 groups "good," "scar," "articular" (with bone or joint lesions) and "poor" (bilateral nerve and vascular lesions) The operation, performed in a bloodless field and with atraumatic technic, largely conformed to the procedure recommended by Bunnell

Fibrosis affected the final results Whereas 80% of patients in the "good" group had a maximum flexion deficit of 3 cm, only 40-45% of those in the "scar" group and about 15% of those in the "articular" group showed similar flexion power When the "good" group (26 patients) was divided in 3 sub-

(8) Acta chir scandinav 111 124 141 1956

groups according to the interval between initial trauma and operation, no significant difference in end results could be found between the subgroups Preoperative conditions greatly influence final results In patients with adequate blood supply, normal sensation, normal passive movements of the finger joints and absence of pronounced fibrosis ("good" group), there is always clear indication for operation While prospects of obtaining a satisfactory functional end result are considerable in this group, prognosis in the "scar" group is much poorer Posttraumatic, postoperative or postinfectious fibrosis greatly reduces the gliding ability of the graft, yet good results can be obtained in the "scar" group, too In the "articular" group, active flexion naturally cannot be expected to be better than the preoperative passive range of movement However, the functional value of a finger is not necessarily proportional to the range of movement of the interphalangeal joints Age and occupation may broaden the indications In grave hand injuries, the indications are wider, since even a slight addition may be of great functional value In unilateral digital nerve lesions, nerve suture should be done before or coincident with the free tendon graft, especially for digital nerves on the radial side of the finger and ulnar side of the thumb Prognosis is good in nerve suture in the finger region Free tendon grafting is of no benefit in the "poor" group, amputation at the proximal interphalangeal joint is indicated

It is suggested that in open lesions of the profundus and sublimis tendons in the fingers, primary treatment should *consist of skin suture only, later, when the state of* the skin permits free tendon grafting should be performed at a second operation In profundus tendon lesions over the proximal part of the middle phalanx, free tendon grafts in the gap between the sublimis slips may sometimes yield good results

As regards the thumb, a long graft should be used with the proximal sutures in the most distal part of the forearm For the fingers, the graft should extend to the origin of the lumbricalis muscle at the profundus tendon Attachment of the graft distally *ad modum* (Bunnell) insures firm anchorage The palmaris longus tendon is ideal as a free graft Its length even suffices for the long grafts required for replacement of the flexor pollicis longus

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ANESTHESIA

Edited by

STUART C. CULLEN, M D.

DEPRESSANT DRUGS

Some Effects of Premedication were studied by Mark Swerdlow and Joyce Newman[1] (Manchester, England) in 200 patients who were given intravenously, in fixed dose/body weight, morphine and papaveretum combined with atropine and scopolamine Changes in pulse, blood pressure and respiration rate and depth were recorded at intervals up to 10 minutes after injection and general effects noted

Blood pressure showed no constant change Rise in pulse rate occurred after all combinations and was generally greater after atropine mixtures Respiration rate showed no significant change Respiratory volume was diminished by all drug combinations, papaveretum caused a significantly greater depression than morphine

Use of the intravenous route for premedication denies the patient the benefits of preoperative sedation and cannot, therefore, be advocated for general use However, occasions arise when this route must be used, as in an emergency, in the shock patient, when premedication has been overlooked or to supplement an inadequate or badly timed dose Intravenous administration does insure rapid action and absorption regardless of circulatory efficiency, and also permits the full effect to be seen before anesthesia is begun A disadvantage is that patients tend to sleep longer postoperatively than after conventional hypodermic premedication

► [The significance of the observations made in this study lies in the corroboration of the distinct influence drugs used for premedication have on the patient —Ed]

(1) Brit J Anaesth 29 66 70 February 1957

Postoperative Pain: Research and Treatment are discussed by Arthur S Keats[2] (Baylor Univ) Certain operations are followed by little or no demand for analgesics, in contrast to intra-abdominal or intrathoracic procedures However, pain is but one symptom of the postoperative patient About 10-15% of all requests for medication are for sleeplessness, discomfort from gastric tube or oxygen catheter, sore throat, headache, backache, uncomfortable position in bed, bladder discomfort from indwelling catheters or tightness and weightiness of casts

The first postoperative day is the most difficult There is little need for narcotics after the second day except when surgical or psychic complications are present Slighter pain may persist for variable periods after operation and is readily controlled by nonnarcotic analgesics

No relation was found between degree of postoperative pain and sex, type and duration of anesthetic, previous medical and surgical histories, previous hospitalizations, obvious personality types, noticeable personality disorder or preoperative pain The frequent pain relief following injections of normal saline showed that suggestion is a factor in relief of pain No adequately studied drug has been found to produce the analgesia of morphine with less side action For the average 150-lb man, 10 mg of morphine is adequate for relief of postoperative pain

Many associated complaints of postoperative patients can be improved by good nursing care A comfortable position in bed with frequent turning and other simple measures, will greatly improve the mental state as well as the "pain" of these patients A lubricant containing a topical anesthetic applied to the gastric tube before insertion will prevent much of the irritation and annoyance of a nasogastric tube Frequent checks to see that the bladder catheter is draining will relieve much bladder discomfort from indwelling catheters Intramuscular sodium pentobarbital, 100 mg/70 kg, is a useful adjunct to a narcotic for routine postoperative treatment of sleeplessness, restlessness, anxiety and nausea For mild pain, it can serve as a substitute for morphine

► [The author clearly documents relatively well controlled observations on the problem of relief of postoperative pain Especial attention should be

(2) J Chronic D s 4 72 83 July 1956

paid to the evidence that need for narcotics is limited and that many factors contribute to the distress of the patient in the postoperative period —Ed]

New Concepts in Action of Analgesic Drugs are discussed by Arthur S Keats[3] (Baylor Univ) Nalorphine is in a sense two drugs Its particular actions depend on the history of previous administration of morphine or other narcotics When given without any previous narcotics, it acts like morphine, when given after morphine, it reverses morphine effects

Normal subjects were given 10 mg morphine intravenously, and the expected respiratory depression was measured by estimation of alveolar Pco_2 and alveolar ventilation while subjects were breathing 100% oxygen or 3-4% CO_2 in oxygen When 10 mg nalorphine was given intravenously 1 hour after morphine, no stimulation of respiration was observed, and in some subjects, a further decrease was produced The same procedure was repeated (when possible with the same subject) with the exception that another subcutaneous dose of 15 mg morphine was administered 5 hours before the intravenous dose of morphine When nalorphine was given, marked stimulation of respiration occurred

The total dose of morphine or the frequency of the dose or perhaps the length of the interval between administration of morphine and nalorphine all seem to influence the antagonistic action of nalorphine These same factors have been described also as affecting intensity of the syndrome of morphine abstinence, hence by definition, the degree of physical dependence

Combinations of narcotic and antagonist evidently do not result in antagonism of some actions and sparing of others e g , analgesia without respiratory depression, despite recent clinical reports Since there are circumstances under which nalorphine is not an antagonist and may even increase the respiratory depression following morphine, it should be used cautiously for diagnosis or treatment of respiratory depressions of uncertain or multiple etiology In treating such depressions a small intravenous dose should be given, and if no antagonistic effect is rapidly obtained, further administration should be abandoned

► [As experience with the narcotic antagonists increases it becomes in

(3) South M J 49 1285 1289 November 1956

creasingly evident that these drugs should not be used indiscriminately and that rather specific circumstances should exist before their application for resuscitative purposes —Ed]

Influence of Opiates on Respiratory Response of Man to Thiopental was studied by Martin Helrich, James E Eckenhoff, Richard E Jones and William D Rolph, Jr[4] (Univ of Pennsylvania) In normal volunteers or relatively healthy patients, respiratory depression produced by thiopental alone was minimal with a total dose of about 500 mg given in 20-25 minutes In some persons, respiratory response to carbon dioxide was even improved after thiopental In contrast was the profound respiratory depression recorded in persons receiving thiopental after injection of morphine or meperidine In a study of the effect on respiration of a large variety of opiate and opiate like drugs, the average depression in response to endogenously accumulated carbon dioxide was of a degree similar to that exhibited by persons who received thiopental after an opiate Therefore, the major part of the respiratory effect of the combination was probably due to the opiate, and addition of thiopental caused little further respiratory depression

These observations concerning the lack of respiratory depression from thiopental should not be misconstrued Thiopental in sufficient dosage does result in respiratory depression even in normal persons All subjects in this study were relatively lightly anesthetized, as judged by clinical signs, blood levels, EEG levels, rate of administration and total dosage

► [This is an example of the difficulties encountered in balancing balanced anesthesia —Ed]

Promethazine in Surgery Preliminary Report Promethazine, a phenothiazine derivative apparently able to influence the central nervous system in a rather benign and predictable fashion lends itself to anesthetic technics commonly used in surgery It acts rapidly and produces a fairly prolonged, excellent degree of sedation There is little or no sign of interference with medullary functions, no flushing or respiratory or cardiovascular depression is seen Mild hypotension may occur when promethazine is used with atropine or a heavy

(4) Anesthesiology 17 459 467 May, 1956

dosage of meperidine or morphine The pulse tends to be slow and strong rather than rapid There is also a distinct impression that this compound affords protection against stress, as do chlorpromazine and similar nervous system depressants

Max S Sadove[5] (Univ of Illinois) reports on more than 1,000 administrations of promethazine in surgical patients It appeared useful as a sedative preoperatively, as a supplement to the milder anesthetics in producing lighter planes of anesthesia and the hypothermic state, as a means of combating emesis and hiccups and as a sedative postoperatively

The dosage schedule recommended is 50 mg promethazine intramuscularly 2 hours before induction, 50 mg meperidine *intramuscularly 45 60 minutes before induction* and 0 4 mg scopolamine or atropine 30 minutes before induction The drug, with or without meperidine, was used with excellent effect in children, and few side effects occurred when given in usual dosages

► [In evaluating this report one should not overlook the fact that the author identifies the observations as 'clinical impressions" No reliable estimate of the effectiveness of these particular preparations in premedication can be obtained unless controlled observations are made The drug enjoys a widespread popularity as a premedicant without adequate scientific support —Ed]

Chlorpromazine—Adjunct to Premedication. Clinical Report Based on 1,100 Cases is reported by Erwin Lear, Albert E Chiron and Irving M Pallin[6] (Jewish Hosp , Brooklyn) Chlorpromazine, 25 50 mg , intramuscularly was given 2 hours before major surgery of short duration, such as thyroidectomy and cholecystectomy, and 1 hour before long procedures, such as chest work and radical bowel surgery Demerol®, 25-50 mg , and scopolamine, 0 2 0 3 mg , were given intramuscularly 1 hour preoperatively Using this method of premedication in 1,100 major operations, the authors found that more than 90% of the patients could be adequately sedated with the amount of Demerol® and scopolamine mentioned These doses represent one half or less of the drugs required for analogous results before the chlorpromazine study was undertaken Relative absence of respiratory depression in these patients, as compared with that in pa

(5) J A M A 162 712 715 Oct 20 1956
(6) New York J Med 55 1853 1857 July 1 1955

tients receiving full doses of Demerol® or morphine (100 mg or 10 mg) without chlorpromazine is significant

After chlorpromazine, the patients accepted the anesthesia mask more readily and were only a little or not at all excited Many patients premedicated with chlorpromazine required less agents to attain and maintain a given level of anesthesia Those who required the usual amounts of agents ran a smooth course—an almost automatic anesthesia Not only was less succinylcholine required for intubation, but less drug was needed for ordinary muscle relaxation in many instances of high abdominal surgery

The most alarming side effect of chlorpromazine was severe hypotension, with pressure readings as low as 50/30 mm Hg With adequate fluid replacement, chlorpromazine hypotension corrected itself in a few hours Renal dynamics appeared to be unaltered in chlorpromazine hypotension

Patients under chlorpromazine are extremely sensitive to postural changes, much as those under spinal anesthesia Poor risk geriatric patients premedicated with chlorpromazine withstood major surgery with less than anticipated difficulties In several patients, chlorpromazine seemed to provide some protection from shock

► [A maximum of credit is given chlorpromazine in circumstances of a minimum of controlled evidence —Ed]

Chlorpromazine. Report of One Death and Eight Near Fatalities Following Its Use in Conjunction with Spinal, Epidural and Celiac Plexus Block is presented by Daniel C Moore and L Donald Bridenbaugh[7] (Seattle) Chlorpromazine is administered to surgical and obstetric patients for its antiemetic and sedative effects Usually it is used without due consideration to its "adrenolytic like" action on the cardiovascular system Chlorpromazine may, by itself lower blood pressure markedly This may not result in a serious situation, but if the effects of a sympathetic block from a spinal, epidural or celiac plexus block are added to this action of chlorpromazine, the systolic blood pressure may fall to 50 mm Hg or lower Occasionally, no blood pressure at all can be detected

A fall in blood pressure of this nature does not respond to

(7) Surgery 40 543 545 September 1956

ordinary vasoconstrictor drugs in the usual doses, but only to phenylephrine (Neo synephrine®), run in a rapid drip or to a strong concentration or levarterenol (Levophed®) The authors observed 3 instances of this complication and were informed of 6 others which occurred in the area It was possible to elevate the blood pressure quickly enough to avoid untoward effects in all patients, except 1 who died, probably of prolonged severe hypotension and the tissue hypoxia which accompanied it Because such severe hypotension may be caused by chlorpromazine, thorough inquiry should be made into preceding medication before a therapeutic or diagnostic block is performed

► [There are many drugs available to produce specific effects such as sympatholysis relaxation sedation etc With these drugs available, one wonders why a "shot gun type of drug such as chlorpromazine has become so popular particularly in view of the relative lack of knowledge of its actions —Ed]

Chlorpromazine as Adjuvant in Relief of Chronic Pain was studied by John W Dundee[8] (Univ of Liverpool) in 76 patients Excellent results were obtained in subjects with malignant disease, but results in other types of pain were not so good These findings were similar to those obtained in 48 similar patients, in whom effects of the treatment were assessed by other practitioners Best results were obtained with a combination of chlorpromazine and levorphan Side effects occurred in two thirds of the patients but necessitated stopping chlorpromazine in only 2 Occurrence of an influenza like attack followed by jaundice was the most serious complication in this study Serum bilirubin and alkaline phosphatase determinations and leukocyte counts should be made *frequently in patients having prolonged treatment with* chlorpromazine Dangers associated with use of chlorpromazine do not appear sufficient to preclude its use in patients with pain due to malignant disease In other conditions, it must be decided whether the benefits likely to be obtained from use of chlorpromazine outweigh the side effects

Management of Postpartum Pain with Dihydrohydroxycodeinone (Percodan®) Evaluation with Codeine and Placebo John J Bonica Dale Hadfield and Blair Bennett[9] evaluated the effectiveness of dihydrohydroxycodeinone as

(8) Brit J Anaesth 29 28 34 January 1957
(9) West J Surg 65 84 88 Mar Apr 1957

an analgesic for moderate pain in 143 postpartum patients, aged 19 38 The patients were studied as soon as they were able to retain oral medication Codeine was used as a stand ard of reference and the unknown technic was used through out For 62 patients a placebo was included In most in stances, the initial dose was given in the first 6 hours after delivery

As shown in Table 1, 89% obtained relief from Percodan®, 72 4% from codeine and 22 7% from placebo Statistical analysis of the data revealed that the average effectiveness of Percodan® was significantly higher than that obtained from codeine or placebos

TABLE 1 —RESULTS OF ANALGESIC TRIALS

EFFECTS	CODEINE		PERCODAN®		PLACEBO	
	Total Doses	%	Total Doses	%	Total Doses	%
Relief	254	72 4	293	89 0	32	22 7
No relief	97	27 6	36	11 0	109	77 3
Total	351	100 0	329	100 0	141	100 0

TABLE 2 —OCCURRENCES OF SIDE REACTIONS

SYMPTOMS	CODEINE		PERCODAN®		PLACEBO	
	No	%	No	%	No	%
Nausea	58	16 52	46	1 39	12	0 85
Vomiting	19	5 43	15	0 46	7	4 49
Dizziness	30	8 55	35	1 06	14	1 01
Headache	18	5 12	13	0 40	0	0 00
Tinnitus	0	0 00	1	0 03	0	0 00
Visual disturbance	2	0 57	2	0 06	1	0 07
Pruritus	5	1 42	4	0 12	2	0 14
Drowsiness	1	0 28	4	0 12	2	0 14
Total	133	37 89	120	36 4	38	27 0

A summary of side reactions to the drugs is given in Table 2 A comparison of Percodan® and codeine showed no significant difference in the proportion of side reactions, or rather change in the proportion reacting

Problems of Analgesia in the Obstetric Patient are discussed by C R Stephen[1] (Duke Univ) The basic problem to provide safe and adequate relief from pain for each mother

(1) Anesth & Analg 35 218 225 May June 1956

without endangering the cardiovascular and respiratory functions of the baby It is essential to prepare the patient throughout pregnancy psychologically and physically for delivery, to overcome tension and fear The over-all result of this preparation for labor is to diminish and, at times, eliminate the dependency of the mother on pharmacologic analgesic agents Need for these drugs tends to be proportional to the degree of apprehension, individual threshold to pain and obstetric complications

All narcotic drugs presently used, when administered to the point of adequate analgesia for severe labor pains, also depress the respiratory center of the mother and fetus Of the several drugs used, probably meperidine is least hazardous, because its duration of action is shortest Short-acting barbiturates act primarily as hypnotics and amnesics In some patients, they cause loss of self-control and patients may become difficult to manage Scopolamine mainly reinforces the sedative action of other drugs and reduces memory of events during labor It does not harm the fetus

Use of local anesthetic drugs to block sensory impulses arising from uterine contractions is ideal for pain relief during labor The mother has uterine contractions without pain, and the fetus is not depressed However, accomplishment of this aim may be difficult If the fetus is to be unharmed, the nerve block must not involve the sympathetic nervous system enough to induce marked hypotension If the nerve block is to be of value and not stop or delay labor, it must block the sensory pathways selectively, with minimal interference to motor function To be practical, the block should be technically simple to perform Cleland stated that anatomically the most feasible place to produce isolated sensory blockade from the uterus is by paravertebral block of the 11th and 12th thoracic roots just before they enter the central canal However, this is difficult to do technically, and there is considerable hazard of injecting into the subarachnoid space, thus producing spinal anesthesia This difficulty can be overcome by producing a limited epidural analgesia at the level of the 11th or 12th thoracic roots

In recent years, trichloroethylene vapor has been recommended as an analgesic during labor Since this is a potent

drug, providing analgesia in concentrations of 0 3 1%, and does not vaporize easily, several inhalers have been devised to allow low and accurate concentrations to be readily inhaled Trichloroethylene can confer marked analgesia and amnesia without loss of consciousness Self administration of this drug is feasible, and effective concentrations of the vapor do not depress the respiratory centers of mother or fetus

► [One should note that in the following report of Roberts *et al* meperidine (Demerol®, pethidine) is not as short acting as it may seem to be at least from the standpoint of its effect on the infant —Ed]

Effects of Mild Analgesics in Postpartum Pain Method for Evaluating Analgesics The difficulty of any technic for assay of analgesic potency rests on the problems associated with the type of pain (real or experimental), mode of action of the analgesic, the high percentage of placebo reactors and the usual variabilities associated with age, sex, physical status, etc Louis R Orkin, Samuel I Joseph and Martin Helrich[2] tried to eliminate as many patient variables as feasible Multiparous postpartum patients who desired something for relief of after-pains appeared an ideal group These women had a similar type of real pain which responded to "mild" analgesics such as codeine or aspirin The patients were categorized automatically as to age, sex, general well being and physical status All had a certain euphoria and sense of accomplishment associated with their motherhood Codeine or aspirin was given to 384 patients a placebo to 371 and unknown analgesics to 444 A placebo relieved pain in about 75% of patients Codeine or aspirin increased the figure to 85% No doubt, a kind word or appropriate bedside manner could do almost as well

Interesting aspects of this investigation were the high incidence of good results with a placebo and the implications of these data in any study of analgesic potency Clinical studies may reveal good results (75% relief) which are erroneous and misleading without adequate control of the experimental factors Batterman held the view that the placebo is not an inert mechanism if the patient is conditioned to expect pain relief

► [The controlled observations included in this report are especially fascinating and revealing because of the tendency to use pain associated with

(2) New York J Med 57 71 73 Jan 1 1957

childbirth as a reliable and constant source for measurement of the effectiveness of drugs —Ed]

Effects of Some Analgesic Drugs Used in Childbirth: With Special Reference to Variation in Respiratory Minute Volume of Newborn. Alteration in minute volume of the newborn in response to various analgesics administered to the mother during labor was studied by Hilda Roberts, K. M.

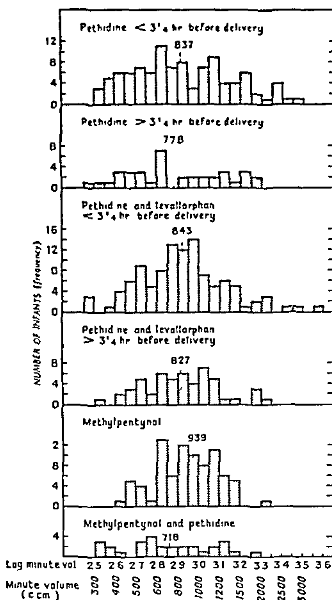


Fig 106 —*Distribution of minute volumes of newborn infants on logarithmic scale (geometric mean)* (Courtesy of Roberts, H , *et al* Lancet 1 128 132, Jan 19, 1957)

Kane, N Percival, P Snow and N. W. Please[3] The mean minute volume of 565 newborn infants in the gas-and-air group was compared with that of 205 in the pethidine/gas and air group Pethidine apparently reduced the volume 10-15% The action of levallorphan as an antagonist to pethidine was studied The mean minute volume of 177 newborn babies of the pethidine/gas-and-air group was compared with that of 178 in the pethidine/levallorphan/gas-and air group The latter showed no significant increase in mean minute volume Methylpentynol was administered to 153 patients in labor, 120 receiving methylpentynol and gas-and air and 33 methylpentynol, pethidine and gas-and-air Of the former group, 66 6% experienced satisfactory pain relief, of the latter 72 7% The mean minute volume of the newborn infants in the group in which pethidine was used was significantly lower than that in the methylpentynol/gas-and-air group (Fig 106) Methylpentynol probably can be of value during labor to produce a sense of relaxation and drowsiness in some patients (about 40%), and to augment the analgesic action of other drugs given later in labor

► [There is a tendency to consider that Demerol® (pethidine) is a short acting narcotic The evidence presented in this report refutes this assumption, and in addition it emphasizes the impact on the infant of drugs given to the mother even after there is no apparent "clinical effect demonstrable in the mother —Ed]

VENTILATION

Anesthesia with Controlled Positive and Negative Pressure Respiration—*I Clinical evaluation*—Allen B Dobkin (College of Medicine, Saskatoon, Sask), Charles A Hubay, Harvey J Mendelsohn and Robert A Hingson[4] (Western Reserve Univ) evaluated a fully automatic pressure respirator in which positive, negative and atmospheric pressures could be timed automatically and controlled by timed delay relay switches for duration of phases and rate of respiration Indicators recorded phase pressures and calibration of the ventilating bellows indicated tidal volume The tidal volume

(3) Lancet 1 128 132 Jan 19 1957
(4) Brit J Anaesth 28 296 323 July 1956

of respiration was delivered through nondistensible (Tygon) tubing from the respirator to the rebreathing inlet of a Heidbrink circle absorber and through semidistensible tubing from the Heidbrink inhalation and exhalation valves to the endotracheal tube During studies, the anesthetist, surgeon, general type of operation, patient's disease and anesthetic method and technic were constant within clinical limits Amplitude of the breathing curve when a subatmospheric phase was added was also held constant, as laboratory and clinical experience showed the pressure used was adequate Variables were restricted to the position and shape of the breathing curve.

It was found that a three-phase respiration cycle, consisting of an accelerating inflow to a pressure peak, a rapid fall to atmospheric pressure and the addition of a subsequent phase of subatmospheric pressure, is of great assistance when high pressures are needed for adequate pulmonary ventilation, when passive deflation is faulty and when difficulty is expected in maintaining near-normal acid base balance and oxygenation because of the type of operation (lung excision) or because of abnormal posture on the operating table (lateral or prone) The subatmospheric phase did not appear to be of added benefit in management of the anesthetic under operative conditions other than those stated

► [It is of interest that the authors recognize and substantiate the need for pressures above the traditional limits in order to provide suitable ventilation in some circumstances It should also be noted that compensation for the period of increased pressure is arranged for by a period of subatmospheric pressure in the cycle —Ed]

II Review of cardiorespiratory function and acid-base homeostasis—Dobkin and Gordon M Wyant[5] (College of Medicine, Saskatoon, Sask) point out that in clinical anesthesia the incidence of respiratory acidosis when the pleural cavity has been invaded for pulmonary or cardiopulmonary surgery remains the most serious problem It can become even more exaggerated by using multiple anesthetic agents When the pleura is open, provision of adequate pulmonary ventilation is a harassing problem to the anesthetist During nonthoracic operations, with the patient supine, arterial pH and P_{CO_2} are a close function of the total ventilation During

(5) Brit J Anaesth 28 353 365 August 1956

intrathoracic operations, however, patients apparently require a much larger minute volume of ventilation than under normal awake conditions.

Data gathered in recent years clearly indicate that management of all general anesthetics requires assistance to the patient's pulmonary ventilation for all operative procedures. Adequate pulmonary ventilation should imply maintenance of oxygen saturation of the arterial blood, elimination of alveolar carbon dioxide to levels which maintain the arterial blood pH within normal range (7.35-7.45) and arterial carbon dioxide tensions between 35 and 45 mm. Hg. This ventilation also should sustain or promote normal cardiovascular function, as indicated by a stable blood pressure and pulse rate.

When the pleura is opened, respiration must be controlled, otherwise the definition of adequate pulmonary ventilation cannot be fulfilled. With manual control, when carried out with close attention to the patient, balanced anesthesia and operative procedure, most patients remain in a near-normal physiologic state. Mechanical respirators are of considerable assistance if the inherent limitations imposed by lowered lung compliance and elevated airway resistance due to cardiopulmonary disease and the mechanical failings of present-day respirators are recognized. Current data contend that both volumes and pressures applied to the patient's airway must be considered for each patient if optimum anesthetic care and management are to be provided.

Anesthesia, Hyperventilation and Peripheral Blood were studied by W. N. Rollason and J. Parkes[6] (Hull, England) in 50 patients. All received the same basic anesthetic technic, which consisted of Pentothal®, pethidine, relaxant and gas and oxygen, but 25 also received a hypotensive drug. Patients were well relaxed and manually hyperventilated with nitrous oxide-oxygen (30%) from a Coxeter Mushin machine for 1-1½ hours with a minute volume of 20 L. and an inspiratory pressure of 15-20 mm. Hg.

After 1-1½ hours of hyperventilation the peripheral venous plasma in 32 patients (64%) revealed Pco_2 of 24-46 mm. Hg, and of 46-67 mm. in 18 patients. In 29 patients, 15 of whom

(6) Anaesthesia 12 61-73, January, 1957

had received a ganglionic blocking drug, the Pco_2 of peripheral venous blood was above that of alveolar air, i e, 40 mm Hg, so tissue alkalosis is unlikely in most hyperventilated surgical patients irrespective of whether they are un-

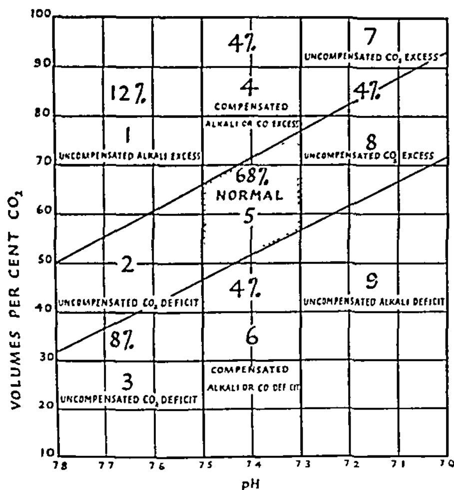


Fig 107 —Preoperative acid base balance (Courtesy of Rollason W N and Parkes J Anaesthesia 12 61 73 January 1957)

der normotensive or hypotensive anesthesia Certain postures, such as the lateral jackknife and Trendelenburg, tend to nullify the effects of hyperventilation by increasing resistance of the pulmonary bed and this resistance is further increased during the positive pressure phase of each respiratory cycle

Further, 25 patients with clinically normal cardiorespiratory systems were studied in greater detail with respect to

hyperventilation. The acid-base balance of the plasma was calculated from the pH of plasma which was brought into equilibrium with alveolar air and the CO_2-combining power. Results in the conscious patient at rest are illustrated in Figure 107. There were 17 patients in the normal range. The

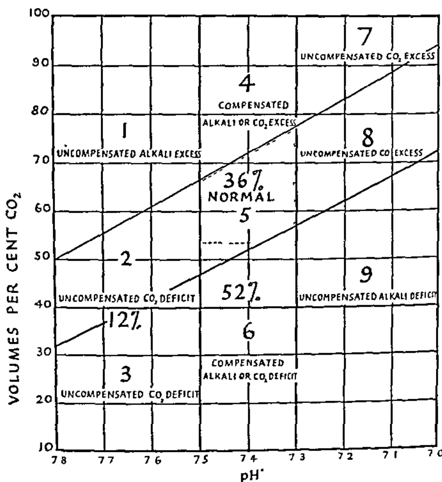


Fig 108—Acid base balance of venous plasma after 1-1½ hours hyperventilation (Courtesy of Rollason, W. N., and Parkes, J.: Anaesthesia 12 61 73, January, 1957.)

acid-base balance after the patients were anesthetized and hyperventilated for 1-1½ hours is shown in Figure 108. Only 9 patients (36%) were in the normal range.

Hyperventilation as gross as is practicable under clinical conditions for 1-1½ hours in the average lightly anesthetized, well-relaxed patient, ventilated with nitrous oxide and oxygen with a minimum of 30% oxygen, is unlikely to produce

harmful respiratory alkalosis The excellent clinical postoperative state of all these patients is in marked contrast to those who have had respiratory acidosis Excretion of alkali by the kidney reflected in the consistent fall in the CO_2-combining power, general retarding of circulation reflected by pallor of the skin, with the resultant small changes in pH and P_{CO_2}, and a CO_2 content higher than the CO_2-combining power in the peripheral venous blood appear to be the body's main compensatory mechanisms in maintaining CO_2 homeostasis in the tissues in the presence of hyperventilation

Significance of Lung-Thorax Compliance in Ventilation during Thoracic Surgery Inadequate ventilation occurs more often during intrathoracic operations, especially during pneumonectomy Effective ventilation is often decreased during intrathoracic operations, and a considerable increase in minute volume is required to provide adequate effective ventilation The change of the volume of gas in the respiratory system/unit increase of the intratracheal pressure is a measure of the distensibility of the lungs and the restriction to expansion imposed by surrounding structures This relation of airway pressure to gas volume within the respiratory system is termed lung thorax compliance, a factor directly related to total volume

In determining factors responsible for inefficiency of ventilation during thoracic operations, William E Brownlee and Frank F Allbritten Jr[7] (Univ of Kansas) studied lung-thoracic compliance in unanesthetized and anesthetized patients with normal and diseased respiratory systems preceding during and following intrathoracic surgery Significant decrease in lung thorax compliance was noted in 11 unanesthetized patients with cardiac and 9 with pulmonary disease when compared with that in 9 normal controls Significant decrease also occurred in 13 unanesthetized patients between the day preceding surgery and the 5th postoperative day

General anesthesia in 11 patients produced an average decrease of 67% in compliance, when compared with that in the unanesthetized state A variable change in compliance oc-

(7) J Thoracic Surg 32 454 463 October 1956

curred when 10 anesthetized patients were shifted from the supine to the lateral position A large decrease occurred in the lateral position in 2 who had extensive disease in the uppermost lung and a large increase in an extremely obese patient in the lateral position

An average increase in lung thorax compliance of 45% was noted in 5 patients when the chest was opened during surgery An average decrease of 17% occurred in 7 when the lung was packed away or retracted to gain exposure when compared with the control measurement taken before the chest was opened An average decrease of 16% occurred during surgery in 5 anesthetized patients when the immediate postoperative measurement was compared with the immediate preoperative measurement

Variation in the person tested occurred in 13 patients during surgery Average decrease was 44% when minimum and maximum compliance were compared

Lung thorax compliance in patients having intrathoracic surgery is influenced by several factors A rather wide range can be expected during operation and there is variation between persons The effect that changes in compliance would have on total volume of pulmonary ventilation during intrathoracic surgery is apparent If fixed inflation pressure were used the elevation of airway pressure necessary for an adequate tidal volume might at times be excessive if inflation alone were used to obtain adequate ventilation Lung thorax compliance merits consideration in providing adequate pulmonary ventilation during general anesthesia for intrathoracic surgery

Inefficient Carbon Dioxide Absorption Requiring Increased Pulmonary Ventilation during Operations Respiratory acidosis during surgical operations is due to inadequate removal of CO_2 from the body This should not occur if sufficient volume of ventilation is supplied to remove CO_2 as rapidly as it is produced Absence of pronounced clinical signs complicates recognition of acidosis Cyanosis may not occur because the oxygen available in anesthetic mixtures being several times that of the atmosphere facilitates adequate oxygenation even in the face of lower ventilatory volumes Carbon dioxide removal does not enjoy the same

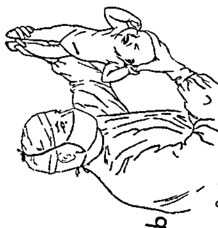
advantage The anesthetic mixture cannot be altered to enhance removal of CO_2 A normal tension of carbon dioxide (P_{CO_2}) in the arterial blood indicates that pulmonary ventilation is adequate

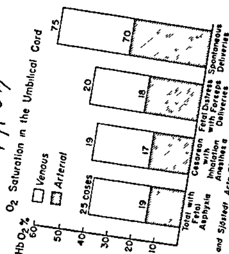
The possibility that a defect in the CO_2 absorption mechanism might be responsible for some of the increase in required ventilation has been suggested Thomas F Nealon, Jr, George J Haupt, Harold F Chase, Joyce E Price and John H Gibbon, Jr[8] (Jefferson Med College Hosp) measured the effect of this incomplete CO_2 absorption on ventilatory requirements during operations on 12 patients Incomplete CO_2 absorption occurred in 2 widely used types of anesthetic machines and was due to improper channeling of the gases through the anesthetic apparatus and use of a widely advertised CO_2 absorbent which proved to be far less efficient than USP soda lime

With incomplete CO_2 absorption in a closed rebreathing circuit, pulmonary ventilation must be considerably increased to avoid accumulation of CO_2 and respiratory acidosis Increases varied between 9% and 93%

Respiratory Emergencies of Newborn are discussed by Roy F Goddard[9] (Albuquerque N M) The fetus in utero lives in a partial oxygen pressure of 35-40 mm Hg (Fig 109, *a*) and its arterial oxygen saturation is roughly 50% of its total capacity At birth, oxygen saturation of the infant rises rapidly to 80-100% (Fig 109, *b*) The anoxic newborn may have a delay in respiratory onset Varying degrees of cyanosis are present, together with atonia and shock, with no response to cutaneous stimuli and decreasing response to drugs The heart beat usually is slow and irregular These symptoms may result primarily from cerebral anoxia rather than pulmonary pathology Whether anoxia is central or peripheral, treatment starts with establishment of a patent airway, followed by administration of oxygen N allyl nor morphine (Nalline®) may be of some value in counteracting central depression due to morphine or its derivatives if there is a good heart beat The lungs offer the most efficient surface for oxygenation of blood, and once regular rhythmic

(8) J Thoracic Surg 32 464 474 October 1956
(9) Rocky Mountain M J 53 708 720 August 1956





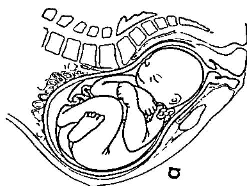


Fig 109 —Factors influencing neonatal respiration (Courtesy of Goddard, R F. Rocky Mountain M. J 53 708 720, August, 1956)

impulses from the respiratory center start, the infant usually expands its lungs effectively thereafter. Intermittent positive pressure-oxygen therapy by mask usually affords sufficient arterial blood oxygenation to induce this sequence Mask pressures of 25-30 cm water repeated 10-20 times at 5-second intervals, followed by pressures of 20 cm. repeatedly over 5-10 minutes usually suffice

Abnormal pulmonary ventilation often is due to the unexpanded lung of the infant who has never breathed and

atelectasis, either the segmental type present at birth or the resorption type which develops in the neonatal period in association with hyaline membrane disease

The clinical picture of the infant who has exerted no respiratory effort is one of cyanosis, atonia, circulatory collapse and no response to reflex irritation Therapy should follow these principles (1) establish a patent airway by gentle nasopharyngeal suction, with the infant slanted downward (10 15 degrees) and the head hyperextended by use of a pad or diaper under the shoulders (2) expand lungs by intermittent positive pressure, (3) promote adequate drainage by intermittent suction to keep the airway clear of mucus and secretions, maintain postural drainage, (4) administer oxygen (*up to 40%*), *when indicated*, (5) *maintain temperature* and humidity, and (6) use gastric lavage and stimulants, when indicated

Postresuscitation measures should include (1) continue resuscitation principles (postural drainage, intermittent positive pressure, oxygen, temperature stimulants), (2) maintain high humidity through water fog or mist incorporating detergents and aerosols, (3) avoid regurgitation and aspiration (nothing by mouth, hydration through mist therapy and hypodermoclysis), (4) prevent infection (intramuscular and aerosol medications), (5) prevent hemorrhage (vitamin K), (6) conserve infant's energy (minimum handling), and (7) achieve gradual adjustment to normal infant routine

Among the congenital anomalies which may involve the upper respiratory tract are cleft palate, laryngeal webs, vascular rings and anomalous vessels, congenital goiters and congenital absence of tracheal rings Varying degrees of respiratory distress are present in these conditions Probably the two most important and frequent reparable conditions associated with respiratory anomalies are tracheoesophageal fistula and diaphragmatic hernia Diagnosis of tracheoesophageal fistula is verified by passing a small catheter into the esophagus The catheter usually meets obstruction at the level of the thoracic inlet Fluoroscopy verifies the position, and Lipiodal® can be injected safely to outline the site and extent of the deformity A fistula between the lower segment and trachea is present in about 80% of cases Three con-

ditions must be met to save the baby (1) secretions from the mouth and nose, which cannot be swallowed, must be kept from overflowing into the trachea, (2) gastric contents must be kept from passing upward through the esophagus into the lung through the fistula, and (3) provision for feeding must be made

Usually an anteroposterior film of the chest is sufficient to establish the diagnosis of a diaphragmatic hernia Surgery should be done within 48 hours

Cerebral lesions responsible for death in the neonatal period frequently are associated with respiratory disturbances in the newborn Symptoms, even when seen alone, may be so similar to those present with pulmonary pathology that diagnosis may not be established until after autopsy

It is difficult to separate the conditions present at birth from those developing in the neonatal period The latter include pulmonary hemorrhage, pneumonia, obstructive emphysema, pulmonary air cysts and hyaline membranes

Observations during Apnea in Conscious Human Subjects Lester Rumble, Jr, Manuel N Cooper, Donald S Bickers John K Schellack, Edward J Waits and Kenneth Hyatt[1] (Atlanta, Ga) measured certain physiologic changes occurring in conscious persons during apnea and compared these changes in the same persons during anesthesia Ten volunteers were paralyzed with succinylcholine, ventilated with pure oxygen, then with nitrous oxide 75%, and oxygen 25%, and finally rendered mildly hypoxic by reduction in the concentration of oxygen During each of the phases, EEG, ECG and respiratory tracings were run simultaneously and arterial and blood determinations were made of the values for oxygen, carbon dioxide, pH, sodium and potassium The minute volume of respiration and subjective response to pain were recorded Simultaneous pressures were measured within the right atrium and anesthesia circuit

The results obtained in this experiment showed adequate oxygenation and removal of carbon dioxide when adequate ventilation of the type described was maintained There was no change in consciousness during the period of hyperventilation with oxygen alone and no change in the values for

(1) Anesthesiology 18 419 438 May June 1957

sodium and potassium The EEG findings were commensurate with those expected for the type of anesthetic being administered, and no ECG changes occurred

Cardiorespiratory Dynamics of Controlled Respiration in the Open and Closed Chest. Archer S Gordon, Charles W Frye and Hiram T. Langston[2] (Chicago) established, by controlled comparative tests, performed on dogs and humans with open and closed chests, the characteristics of the "physiologically ideal" controlled respiration curve on the basis of arterial oxygen saturation, P_{CO_2} and blood pressure determinations

1 Shape The curve should show a gradual pressure rise to a short inspiratory plateau, followed by an abrupt expiratory fall to a longer expiratory plateau

2 Position Positive-negative pressure (PNP) provides over-all superior controlled respiration in the closed chest This is due to the effect of the negative phase in lowering mean airway pressure so that the deleterious effect of the inspiratory positive pressure on cardiac refill (and ultimately on cardiac output and arterial blood pressure) can be compensated for during the expiratory phase With the open chest, use of a negative pressure phase provides no significant circulatory benefit and, if excessive, may be harmful to ventilation Intermittent positive pressure (IPP) breathing is recommended in the open chest, except under special circumstances

3 Amplitude Positive pressure of about 15 mm Hg is required to provide uniform alveolar ventilation This influences oxygenation and carbon dioxide elimination Negative pressure, when used, serves only to lower the mean airway pressure in the closed chest, avoiding circulatory embarrassment With the unilaterally open chest, the lung can collapse after each inspiratory phase, due to loss of intrathoracic negativity Pressure-volume studies indicate that slightly more pressure is usually required for adequate reinflation in the open than in the closed chest With a properly shaped curve, a low mean airway pressure can be attained even with these positive pressure phases The usual PNP range for the closed chest should be about 15— —5 mm Hg, and

(2) J Thoracic Surg 32 431 453 October 1956

the usual IPP range for the open chest should be about 0 16 mm Hg

4 Inspiratory expiratory ratio For both PNP and IPP in the open or closed chest, a 1 2 ratio of inspiration to expiration provides optimal ventilation and is least deleterious to the circulation Duration of inspiratory positive pressure influences blood pressure on the basis of the mean airway pressure and the number of heartbeats during the positive phase Under certain conditions, it may be advantageous to vary this ratio

5 Rate A controlled respiratory rate of 12/minute is adequate for most adults For infants and children, the rate should be increased and varied according to their age and size

This curve form compares favorably with the so called normal airway pressure pattern obtained by use of a large closed circuit reservoir The curve form and characteristics can be produced by a time-cycled controlled respiration and resuscitation unit such as that used by the authors or by manual compression of the anesthesia bag (IPPB only)

Respiratory Adjustments to Increases in External Dead Space Gordon B Clappison and William K Hamilton[3] (State Univ of Iowa) determined, under resting conditions, the respiratory responses of normal, unanesthetized subjects to a small (125 cc) increase in external dead space Such increases added to a "minimum" external dead space of 40 cc caused statistically significant changes in tidal and minute volume and end expiratory P_{CO_2} This indicated that even in unmedicated normal subjects, adjustments to increased dead space of this degree are not complete

The small increases in external dead space found particularly in anesthesia equipment, inhalation therapy apparatus and devices for measuring respiratory functions are significant, even in normal subjects who can compensate at least partially In the presence of disease and depression produced by various drugs in which the patient is incapable of compensating by himself, this increase of dead space seems even more important This would apply especially in the patient with severe pulmonary disease who may already be function-

(3) Anesthesiology 17 643 647 Sept Oct 1956

ing at or near maximum ventilatory capacity The relatively small decrease in dead space obtained by tracheotomy might help

T Piece Technic in Anesthesia: Investigation into Inspired Gas Concentrations was conducted by John S Inkster[4] (Univ of Durham), who used a mechanical "patient" The apparatus consisted of a pump, the rate and stroke of which were independently variable A reservoir bottle, the capacity of which could be altered by addition or removal of acidulated water, was interposed between the pump and tubing, of bore and capacity such as to represent the dead space Alteration of the capacity of the reservoir bottle permitted the correct value for the lung volume of a particular "patient" *to be reproduced, and CO_2 was conveniently introduced at* the appropriate rate

Samples of gas were aspirated from the distal end of the "trachea" and the CO_2 and nitrous oxide concentrations determined by passing the sample through an infra-red gas analyzer Sampling was automatic Electromagnetic valves were opened at any desired phase of the respiratory cycle by a cam on the axle of the motor driving the respiratory pump This allowed suction from a small pump to be applied through the infra-red analyzer to the sampling point

In this system, the factors which influenced the CO_2 content of the inspired gases and the extent to which they were diluted with atmospheric air were the rate of fresh gas inflow CO_2 production, minute volume of the patient and capacity of the limb on the T piece

The relative importance of different variables could be demonstrated by comparing the effect on the inspired CO_2 percentage of altering the minute volume, by changing the rate and by changing the tidal volume A much more significant alteration in inspired CO_2 concentration resulted when the minute volume was altered by changing the depth rather than the rate of respiration

The relative importance of the capacity of the limb was investigated An arbitrary point for fresh gas inflow equivalent to 150% of the minute volume was chosen and the capacity of the T piece increased in 20 mm increments On each of

(4) Brit J Anaesth 28 512 519 November 1956

these occasions the "effective" dead space was measured "Alveolar" gas samples were obtained by altering the size and position of the cam, and since tidal volume and CO_2 output were known, the effective dead space could be calculated It was found that at a fresh gas inflow equivalent to 150% of the minute volume, no increase in the effective dead space above the anatomic value resulted until the capacity of the limb exceeded 30% of the tidal volume

Alterations in effective dead space caused corresponding changes in inspired CO_2 concentrations The effective dead space in any given instance depended on the fresh gas inflow, and with a fresh gas inflow equal to twice the minute volume the effective dead space was equivalent to the anatomic value only, and inspired CO_2 concentrations were negligible

► [To those who have tried to distinguish among *open semi open* and *semi closed* methods this is not new or different Inkster has shown a transition from *open* to *semi open* anesthesia without the features of *semi closed* What he has done is merely a straight rebreathing bag approach to Elam s bag and mask study (without canister) and he should have arrived (as he did) at the 1 8± × minute volume that Elam proposed This is a very nice demonstration of the conditions under which one can enjoy the simplicity and safety of a T tube without losing the effect of N_2O or having the danger of CO_2 collection And in an era of decent vaporizers the consequences of high flows are not so bothersome —Ed]

Resistance to Breathing by Apparatus Used in Anesthesia II Valves and Machines According to Louis R Orkin Mitchel Siegel and E A Rovenstine[5] (New York), resistance to breathing in the anesthetized patient is the summation of the resistances imparted by the natural air passages and the anesthetic appliances Resistance to flow of gases through endotracheal equipment is a function of diameters, constrictions type of flow and flow rates Mixtures of laminar and turbulent flows cannot be divorced from flow rates and does not follow any pattern of simple mathematical formulation The authors studied the function of commonly employed valve systems and anesthesia machines subjected to rates of flow up to and including 95 L /minute

The following valves were studied mushroom or Henderson Haggard valve, flap valve used in the Digby-Leigh nonrebreathing valve, Sadd valve, Gordh or large umbrella valve and "J" or 11 2 valve Valves were removed from their housing before testing Though the Sadd valve appears

(5) Anesth & Analg 36 19 27 Mar Apr 1957

to have an advantage over the others, it varies greatly in quality, is likely to develop leaks and it necessitates housings, which increase resistance When a valve is enclosed in its housing, considerable change in its resistance may occur Effects of a housing are additive to that of the valve per se

Mechanically, the simplest anesthesia machine is the nonbreathing valve The two types most commonly used at present are the Stephen-Slater or its modification by Fink The valvular elements of each is composed of a small, umbrella-shaped rubber disk with stem Differences in resistance between these valves are a function of turbulence in the housing or limitation of the opening distance in the Fink

Anesthesia machines usually contain a device which proposes to control the positive pressure of escaping gaseous mixtures These blow-off valves are of three basic designs spring loaded, employed by Heidbrink and McKesson, orifice limited, as in the Neff valve and weight limited, found on E & J and the new McKesson machines All are satisfactory only at a rate of flow less than 10 L /minute

Anesthesia machines are essentially a means of delivering measured decompressed gases into a reservoir From the reservoir or rebreathing bag, delivery to the patient necessitates physical work in the form of pressure gradients Two basic developments of the reservoir system are used, the circle and the To-and-Fro machine The circle type has a greater number of designs than the latter Circle types all use directional valves Resistance is greater in inspiration and expiration In both phases of respiration, the To and-Fro machine has a decided advantage

Use of Tracheotomy in Association with Artificial and Controlled Respiration is discussed by Thomas G Nelson, Howard K Pedigo and Warner F Bowers [6] If respiratory arrest occurs suddenly in a patient who already has a tracheotomy in place, respiratory exchange can be maintained simply and effectively with a rubber tube and a source of oxygen (Fig 110) The tube is tightly inserted into the cannula, and oxygen flow started A side vent in the tubing allows oxygen flow to the lungs to be increased or decreased by closing or opening the vent Because of leakage of oxygen

(6) Anesthesiology 18 77 87 Jan Feb 1957

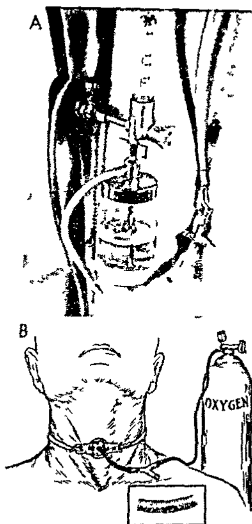


Fig 110—Simple device for artificial respiration using tracheotomy opening *A* rubber tube attached to wall oxygen supplied from central source *B* tank as source of oxygen Tube is fitted tightly into tracheotomy opening and by opening and closing side vent inspiration and expiration can be simulated Side vent may be Y shaped glass connector or (*inset*) a hole in the tubing Reducing valve between delivery tube and tank pressure is advisable but not essential if lungs are not over inflated. (Courtesy of Nelson T G *et al* Anesthesiology 18 77 87 Jan Feb 1957)

through the larynx, a high rate of flow is necessary This leakage can be diminished by placing a gauze pack in the pharynx or by closing off the nose and mouth This method is temporary, it is best suited for emergencies but can be used for prolonged periods if necessary Among methods for longer respiratory resuscitation, the Jefferson automatic positive and negative flow respirator used with an anesthesia apparatus seems best At present, the extracorporeal res-

pirator is the best method of providing prolonged respiratory assistance Nearly every patient who requires the respirator should have a tracheotomy The authors observed no complications or deaths due to use of tracheotomy in association with the respirator Endotracheal anesthesia was administered 101 times through the tracheotomy in patients with burns, maxillofacial and head injuries and head and neck tumors There were no disadvantages, complications or deaths resulting from this use of tracheotomy

When tracheotomy is used as a route for anesthesia or in some forms of artificial respiration, the cannula must be removed and replaced with an endotracheal tube Excision of a piece of anterior tracheal wall and division of the thyroid isthmus in guarding against loss of the airway during such exchange of instruments is important This technic has the same advantages in protecting the airway should the cannula become dislodged accidentally or need replacement with a bronchoscope or another cannula

► [One could readily debate with the authors the idea that the extracorporeal respirator is the best method for prolonged respiratory assistance The authors also give the impression that the mechanics of assistance to ventilation is a primary factor in determining need for tracheotomy Tracheotomy is needed to facilitate cleaning of the airway, to reduce dead space etc, and the decision to establish a tracheotomy is largely independent of the type of ventilator to be employed —Ed]

Changes in Oxygen Saturation during Bronchoscopies were studied by Thomas J DeKornfeld and Karl L Siebecker[7] (VA Hosp, Madison, Wis) in 50 men, aged 22 26 All but 1 had some pulmonary pathologic condition

As shown in Table 1, an average of 50 observations were made before, during and immediately after the procedure,

TABLE 1 —Study of Oxygen Saturation in 50 Patients

	Preoperative	Anesthesia			Supine Position	Bronchoscope in	Right Main Stem Bronchus		Left Main Stem Bronchus		Bronchoscope-out	Postoperative
Limits	86 99	87 100	88 101	89 100	86-100	87 100	86 10?	89 10?	87 103	84 103	87 101	77 101
Average	93	95 1	96 1	96 9	95 1	97 1	98 3	98 4	98 4	98.5	96 3	9? 4

with a time lapse of about two minutes between observations Recordings were made continuously throughout the procedure, but for simplicity and clarity, the table includes

(7) Anesthesiology 18 466 469 May June, 1957

only 3 made during the anesthesia One was made when the patient's position was changed, 1 when the bronchoscope was introduced into the trachea, 2 each when the right and left main stem bronchi were examined, 1 when the instrument was withdrawn from the trachea, and 1 two minutes after the end of the procedure

Table 2 shows the results in 3 patients, illustrating the similarity of the oxygen saturation pattern despite differ

TABLE 2—COMPARISON OF OXYGEN SATURATION IN 3 PATIENTS AND DESCRIPTION OF PATIENTS INDICATING DISEASE VITAL CAPACITY AND TIMED VITAL CAPACITY

Patient No	Preoperative	Anesthesia			Supine Position	Bronchoscope in	Right Main Stem Bronchus		Left Main Stem Bronchus		Bronchoscope out	Postoperative
1*	96	99	100	100	99	100	100	100	100	100	98	96
2†	96	98	99	99	95	96	97	99	99	99	98	97
3‡	95	97	97	97	96	98	99	98	98	99	[illegible]	94

*White man aged 31 No pulmonary disease No pulmonary function studies
†White man aged 38 Moderately advanced tuberculosis right upper lobe Vital capacity 107% *timed vital capacity 89% (second sec)*
‡White man aged 47 Far advanced tuberculosis bilateral Vital capacity 88% timed vital capacity 62% (second sec)

ences in the patients' pathology and pulmonary function These results indicate clearly that during bronchoscopy the arterial oxygen saturation does not fall On the contrary there is a rise in the oxygen saturation without the addition of oxygen to the inspired atmosphere This rise is thought to be due to increased ventilation

► [There will be danger in assuming that desaturation will not occur (even to alarming degrees) in all patients subjected to bronchoscopy There will be patients with limited pulmonary reserve with deficient musculature with
etc
to cc

CIRCULATION

Blood Volumes in Anesthesia Volume of the circulating blood may be determined after intravenous injection of a known quantity of radioactive isotope This determination is based on the principle that the dilution of radioactive material varies directly as the total circulating volume of the

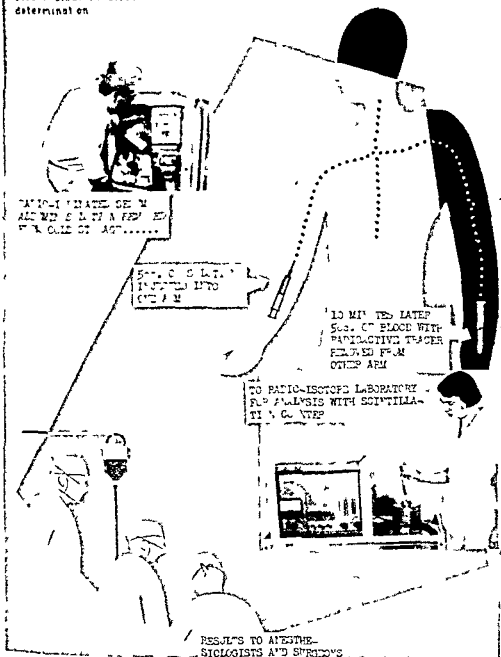


Fig 111 (Courtesy of Wasmuth, C E, and Hale, D E Anesth & Analg 36 54 58, Mar Apr, 1957)

blood The calculation is based on the radioassay of a sample of blood withdrawn from the circulation after an interval of mixing Two isotopes have been used, Cr^{51} and I^{131} Carl E Wasmuth and Donald E Hale[8] (Cleveland Clinic) present the technic of using I^{131} in the form of radioactive iodinated human serum albumin (RISA), which permits rapid

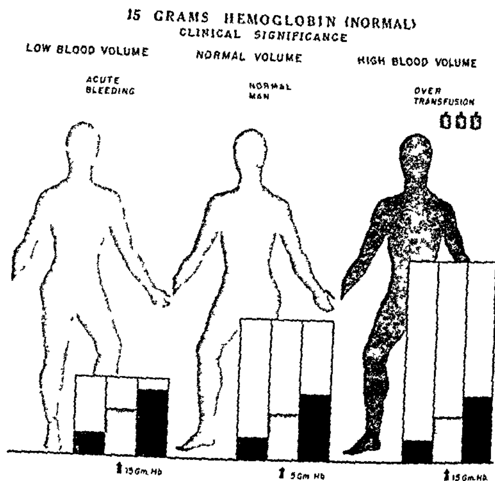


Fig 112 (Courtesy of Wasmuth C E and Hale D E Anesth & Analg 36 54 58 Mar Apr 1957)

and repeated determinations of blood volume A standard solution of the isotope is always available, and results can be obtained a few minutes after injection These advantages permit measurement of the amount of blood lost during operation and management of blood transfusion before and after anesthesia (Fig 111)

Blood volumes cannot be inferred from laboratory esti-

(8) Anesth & Analg 36 54 58 Mar Apr 1957

carbon dioxide excretion No correlation was found between elevation of total peripheral resistance and arterial P_{CO_2} increase in arterial blood pressure and P_{CO_2} and decrease in cardiac output and P_{CO_2} Therefore, it is unlikely that the observed hemodynamic changes were influenced by the P_{CO_2} or increased pH

► [There is good reason to believe that carbon dioxide accumulates with hypoventilation associated with cyclopropane anesthesia and that this contributes to arterial hypertension For those who have felt for some time that something other than carbon dioxide retention was responsible for arterial hypertension with cyclopropane here is reasonable evidence The question may be raised also with regard to the relationship of postcyclopropane hypotension and carbon dioxide—perhaps the removal of a pressor factor with the removal of cyclopropane may be responsible for the hypotension —Ed]

Effects of Cyclopropane Anesthesia on Circulation of Human Beings Murray C Thompson Robert T Patrick and

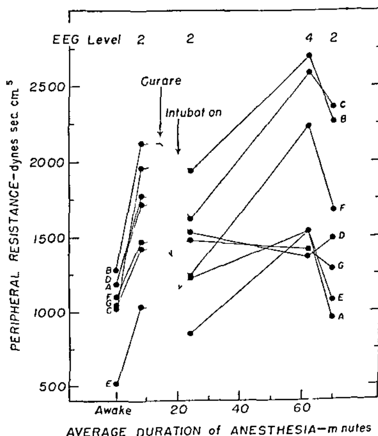


Fig 113 —Changes in peripheral resistance during cyclopropane anesthesia Increase varies directly with depth of anesthesia Letters *A G* represent patients (Courtesy of Thompson M C *et al* J A M A 164 389 393 May 25 1957)

Earl H. Wood[1] (Mayo Clinic and Found.) studied the hemodynamic variables in 7 surgical patients at different EEG levels of cyclopropane anesthesia. The cardiac index and pulse rate decreased with increasing depth of anesthesia. The stroke volume showed no significant change during light anesthesia; during deep anesthesia, a decrease was noted. Peripheral resistance increased with increasing depth of anesthesia (Fig. 113). An increase in arterial blood pressure over preanesthetic levels was observed at all levels of anesthesia. There was no consistent change in calculated central blood volume, but a moderate increase in central venous pressure occurred during anesthesia. The hemodynamic alterations during cyclopropane anesthesia rapidly returned toward preanesthetic values on lightening of the level of anesthesia.

Cardiac arrhythmia occurred in one patient, but only during deep anesthesia and coexistent with a low pH of arterial blood and depressed respirations. This was the only patient whose respirations were unassisted

Blood Pressure Changes during Cesarean Section are discussed by Hugh J. Forthman and John Adriani[2] (New Orleans). A hypotensive syndrome associated with the supine position, late in pregnancy, has been described before. Blood pressure decreases and pulse accelerates when the patient assumes the supine position. The hypotension is accompanied by sweating, clamminess and other symptoms of shock. Relief follows assumption of the lateral or upright position. It has been suggested that the mechanism causing hypotension during spinal anesthesia is the same as that which causes the hypotensive syndrome. Besides hypotension, hypertension is often noted, usually after delivery of the baby or placenta It sometimes assumes alarming proportions.

The authors studied 595 cesarean sections performed with all types of anesthesia. Among 391 cesarean sections done with spinal anesthesia, significant hypotension developed soon after induction of anesthesia in 321 (82%). In 54% of sections done under spinal anesthesia, blood pressure rose 20 mm. or more shortly after delivery. The changes seen when

(1) J A M A 164 389 393, May 25, 1957
(2) Anesth & Analg 36 63 66, Mar Apr, 1957.

spinal anesthesia was used did not occur to a significant degree when general or local anesthesia was used

The fact that vasopressors corrected the hypotension in patients who had spinal anesthesia and that hypotension did not appear when general or local anesthesia was used casts doubt on the theory that the hypotension is due to the weight of the uterus compressing the abdominal veins, and interfering with venous return to the heart In no instance were blood or other fluids used to correct the hypotension Several factors appear to be involved in causing hypertension following delivery What they are cannot be determined without further study

Ballistocardiogram Aid in Evaluation of Anesthetic and Surgical Risk Kuo Chen Wang and William S Howland[3] (Mem'l Center for Cancer, New York) did a comparative study of the value of history and physical examination, ECG and the ballistocardiogram as prognostic aids in evaluating 184 unselected patients, aged 16 91, scheduled for major surgery for cancer in various sites The ballistocardiogram was the best means of estimating cardiac function and ability of the patient to withstand anesthesia and surgery Most major and minor complications and all the deaths occurred in patients with advanced ballistocardiographic changes

Although some correlation exists between the grade of ballistocardiographic tracing and the extent of ECG changes, the ballistocardiogram is often of considerable value in differentiating the degree of the myocardial function in patients with similar abnormalities of the ECG The ECG evidence of a previous myocardial infarct, bundle-branch block or auricular fibrillation is usually suggestive of impaired myocardial function However, such ECG changes can be associated with all grades of cardiac function as expressed by excellent to poor ballistocardiographic changes This may account for differences in response of patients to anesthesia and operation

Measurements of Mechanical and Electric Events of Cardiac Cycle I Effect of Tachycardia, Preanesthetic Medication and Diethyl Ether Anesthesia In diethyl ether anesthesia respiratory paralysis usually precedes onset of frank

(3) Anesthesiology 17 578 584 July Aug 1956

cardiac failure, but certain definite cardiac effects of ether are known to result from its use in clinical dosage particularly shifting pacemaker, extrasystoles and diminished cardiac output George C Sutton, David M Little, Jr and John McClung[4] (US Naval Hosp, Great Lakes, Ill) studied the temporal relationships as recorded on the ECG, phonocardiogram and carotid arterial pulse wave records, in human beings under conditions of changing cardiac rate and ether anesthesia The intervals between onset of the QRS complex and onset of the first heart sound and of the carotid arterial pulse wave rise, between the first tone and onset of the carotid arterial pulse wave rise and onset of the second tone were related to change in cardiac rate

Cardiac acceleration produced consistent shortening of the indirectly measured isometric period of the left ventricle due largely to shortening of its mechanical phase

Results obtained during deep ether anesthesia indicated that this type of anesthesia produced inhibition of rapidity of both electric and mechanical events within the myocardium

Investigation of Cerebral Damage Following Induced Hypotension is reported by Ole Berg, Eric Nilsson and Erik Vinnars[5] (Univ Hosp, Lund) Under induced hypotension, in about 50% of the patients the hexobarbitone flicker fusion test was positive and suggested a varying degree of diffuse cerebral injury Patients with advanced cancer were particularly vulnerable More males seemed to be affected than females A decrease in the blood pressure below 80 mm Hg, in combination with elevation of the head end of the operating table, considerably increased the risk of cerebral injury The cerebral injuries and their symptoms, even the more severe ones, were transient and soon disappeared These injuries were comparable to those of hypoxia and it is known that repeated periods of hypoxia can have a cumulative effect

Patients should not be subjected repeatedly to hypotensive anesthesia without an interval long enough to permit recovery from any injury sustained

► [The increasing use of deliberate hypotension may lead to some indifference to ischemia (hypoxia) especially in the brain Here is evidence

(4) Am J M Sc 232 648 653 December 1956
(5) Brit J Anaesth 29 146 150 Apr 1 1957

that hypoxia does occur Note that recommendation is made to avoid repetition of ischemia before repair takes place This warning can also apply to states of hypoxia otherwise produced —Ed]

INHALATION

Group Pharmacology of Anesthetic Agents: I Absorption-Elimination of Inhaled Drugs is discussed by A R Hunter[6] (Royal Infirm, Manchester, England) If one excludes consideration of the gas which passes from the lung across the alveolar membrane, the time required for this phase of induction of anesthesia can be regarded as constant, irrespective of the agent used In persons with healthy lungs, it is complete in about 2 minutes When disease interferes with mixing of the entering gases, this part of induction may be prolonged to 7 minutes, but never longer

Essential factors controlling entry of an anesthetic into the blood stream are twofold First, the anesthetic must cross the aveolar membrane, which from the physicochemical viewpoint can be regarded as a watery solution of protein Second, it must enter into solution in the blood stream The factors governing the first process are partial pressure of the anesthetic drug in the alveolar gases and solubility of its vapor in water Those influencing the second process are solubility of the anesthetic in blood and again partial pressure of its vapor The rate of diffusion of gases and vapors in any situation is inversely proportional to the square root of their vapor densities

For consideration of absorption across the alveolar membrane, anesthetic agents have been divided into three classes The first includes substances like diethyl and divinyl ether which have a high solubility in water and blood and pass rapidly across the alveolar membrane and into the blood at a rate in excess of the speed at which comparable amounts of the vapor are taken in with inspired air There thus is a tendency for a deficit to develop between partial pressure of the ether in the inhaled mixture and that in the alveoli (Fig 114) Further, as the solubility of ether vapor in blood is high, the tension rises slowly Because of these 2 factors, entry of

(6) Brit J Anaesth 28 244 250 June 1956

ether into the blood during anesthesia induction is always slow.

The second group is exemplified by nitrous oxide and ethylene, which have moderate solubility in water and blood.

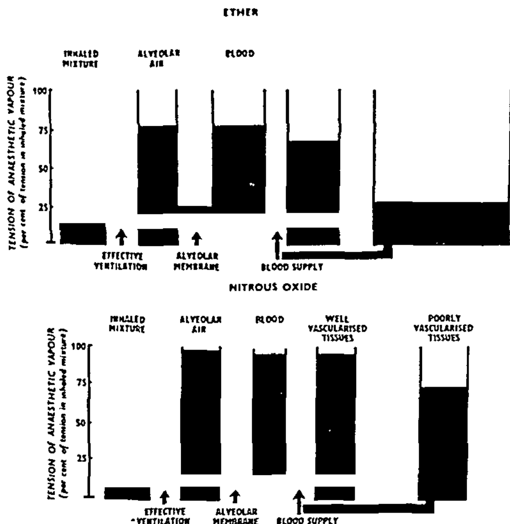


Fig 114 (top) —Absorption and distribution of ether Area of each section shows capacity of that structure for the drug, shaded portion, amount actually present after anesthesia induction Note high solubility in alveolar membrane and blood, lower concentration in alveolar air than in inhaled mixture

Fig 115 (bottom).—Absorption and distribution of nitrous oxide Note moderate solubility in alveolar membrane, blood and tissues

(Courtesy of Hunter, A R Brit J Anaesth 28 244 250, June, 1956)

They pass across the alveolar membrane at a slower rate than ether, but their water solubility is such that they can cross in quantity sufficient to insure early equilibrium between tension of the anesthetic in the blood leaving the lungs and its partial pressure in the aveolar air (Fig. 115).

Because the actual amount of anesthetic taken up by the circulating blood is considerably less than that which finds its way into the lungs at a single breath, there is little tendency for a deficit to develop in the lungs, compared with the concentration in the inspired mixture

The last group contains those anesthetics with low water and low blood solubility, such as chloroform, trichlorethylene and cyclopropane With these agents, the inhaled anesthetic finds great difficulty in escaping from alveoli into the blood and blood tension tends to remain considerably under the partial pressure of the drug in the alveoli

During the induction of ether, the essential problem is to obtain rapid entry of large quantities of ether into the lungs whence it will find its way without difficulty into the blood stream This can be accomplished by hyperventilation with carbon dioxide or by having the patient inhale an anesthetic mixture containing an amount of ether considerably in excess of that which, at equilibrium, would produce an anesthetic concentration of the drug in the blood stream The latter technic has been employed for many years

During ether anesthesia, the apparently diminishing resistance of the patient results from 2 factors—gradual disappearance of the deficit between the tension of the drug in the blood and its partial pressure in the inhaled mixture, and gradual increase in saturation of the tissues with ether, with the result that administration of the same amount of the drug now produces a much greater rise in blood concentration This law is not applicable to patients under nitrous oxide The law of diminishing resistance also is applicable to anesthesia with chloroform, trichlorethylene and cyclopropane

After absorption into the blood stream, anesthetic drugs are distributed to the body tissues Rate of uptake by any individual structure depends on its blood supply and solubility of the anesthetic in it Tissues in which the agent *is relatively* insoluble achieve equilibrium with the blood concentration fairly quickly because uptake of a small amount leads to a large *increase in drug tension* Tissues in which the drug is very soluble, except those with profuse blood supply, take a long period of exposure to reach equilibrium The reflection

of the passage of any substance from blood into the tissues is an arteriovenous difference in its concentration A patient in whom ether is passing from the blood into the tissues shows a difference in concentration which diminishes progressively to the point of complete saturation

The laws governing elimination of anesthetics, after administration are exactly similar to those governing uptake While within the first few minutes after withdrawal of any agent its blood concentration and its concentration in pulmonary alveoli fall to relatively low levels, elimination of anesthetic drugs from the tissues is much slower One important difference between absorption and elimination is that, during absorption, the drug gets to the brain more quickly than to other organs so that onset of unconsciousness is relatively rapid During recovery tension of the anesthetic in the brain must of necessity remain always just a little higher than the concentration of the general venous blood Thus, as long as the less vascular tissues are pouring anesthetic into the blood stream it is impossible for the central nervous system to recover completely even though its blood supply is such that were it isolated from the rest of the body, all the anesthetic could be removed from it in a comparatively short time

Human Cardiovascular Response to Fluothane® Anesthesia Fluothane® is a colorless liquid with a pleasant, nonirritant odor which boils at 50 2 C It is a new, nonexplosive, volatile anesthetic agent Michael Johnstone[7] (Royal Infirm Manchester, England) reports on its administration to 500 patients, including many with cardiovascular, pulmonary, renal and hepatic diseases complicating the surgical lesions Each patient has premedication with atropine, alone or with pethidine, and anesthesia was usually induced with a sleep dose of thiopentone Smooth and rapidly reversible anesthesia was maintained in all patients by continuous administration of Fluothane® vapor, using a Boyle vaporizer and a gas flow of 10 L/minute with 50% oxygen and nitrous oxide

Cardiovascular changes suggesting depression of sympathetic activity were consistently observed and to some ex-

(7) Brit J Anaesth. 28 392-410 September 1956

tent were modified by atropine and by the strength of vapor concentration inhaled No shock syndrome develo[illegible] Salivary, mucous and bronchial secretions were absent in patients throughout anesthesia Nausea, vomiting retching during recovery occurred in less than 10% V[illegible] cardiac arrhythmias were associated with higher concen[illegible] tions of Fluothane® vapor but could be prevented by a[illegible] quate atropine Ventricular arrhythmias occurred with adequate ventilation in lightly anesthetized subjects were mild Cardiovascular collapse followed combined of d-tubocurarine and controlled respiration on patients an[illegible] thetized with Fluothane® Such reactions did *not* occur w[illegible] suxamethonium and controlled respiration were used w[illegible] Fluothane® Tachypnea occurred during surgical stim[illegible] tion in patients lightly anesthetized with Fluothane® [illegible] reaction could be controlled by pethidine or by regi[illegible] nerve block No deaths occurred during Fluothane® an[illegible] thesia

Fluothane® Nonexplosive Volatile Anesthetic Agent [illegible] administered by R Bryce-Smith and H D O'Brien[8] (U[illegible] of Oxford) as the sole or principal anesthetic to a numbe[illegible] volunteers and to 310 patients (aged 7 months to 91 ye[illegible] for various surgical procedures There were no deaths un[illegible] anesthesia in the series although many of the patients w[illegible] in poor physical state

Since Fluothane® does *not* stimulate pharyngeal se[illegible] tions, premedication with atropine is *not essential*, atro[illegible] is advisable, however, to counteract the marked brady[illegible] dia encountered in deep and protracted anesthesia Induc[illegible] is smooth rapid and not unpleasant even by open drop t[illegible] nic Recovery is also rapid and not unpleasant Rang[illegible] anesthetic concentrations lies at 1-3% Fluothane® in air, within these limits adequate conditions can be provided most surgery In upper abdominal operations, muscular laxation is not always perfect

Fluothane® usually causes slowing of the pulse rate fall in blood pressure but these do not appear to be harm[illegible] Excessive falls in blood pressure or pulse rate can quickl[illegible] treated by injection of atropine or methyl amphetamin[illegible] administration of ether The greatest disadvantage of F[illegible]

(8) Brit M J 2 969 972 Oct 27 1956

thane* is the depression of respiration which sometimes occurs, and which may be sufficient to cause cyanosis and CO_2 retention These undesirable features may be overcome by assisting or controlling respiration, which also permits greater depths of anesthesia and increases the scope of this agent This disadvantage is great enough to warrant limiting use of the agent to all but skilled anesthetists until more is known of its properties Perhaps such disturbances of respiration can be avoided by improved technic

► [From personal experience and from other reports this agent has more promise than many other new drugs introduced into clinical anesthesia —Ed]

Effect of Cyclopropane and Ether on Oxygen Consumption in Unpremedicated Surgical Patient was studied by *Marjorie J Topkins and Joseph F Artusio Jr*[9] *(New York) in 23* subjects The metabolic rate was determined after anesthesia and during operation, using a spirometric technic Comparisons were made with preanesthetic levels The mean percentage change during ether anesthesia was +9% and during cyclopropane +15% This increase is small when associated with general inhalation anesthesia but is significant for cyclopropane and is in the same direction for ether when oxygen consumption during anesthesia is compared with basal oxygen consumption The slight further increase in oxygen consumption observed when surgery is added to cyclopropane anesthesia probably is due to the use of intravenous glucose or whole blood

The duration of the surgical procedure has no appreciable effect on oxygen consumption as recorded in observations made up to 4 hours after onset of the operation

It also was found that anesthesia to the depths studied did not depress total body metabolism If anesthesia is associated with depression of metabolism, then the depression must be limited to specific tissues whose total mass is insufficient to produce any decrease in total oxygen consumption Such tissue may be nerve tissue or, more specifically, the synaptic elements in nerve tissue

Use of Endotracheal Cuff Some Data Pro and Con are discussed by John Adriani and Morton Phillips[1] (New Orleans) Pressures necessary to inflate conventional endotra-

(9) Anesth & Analg 35 350 356 July Aug 1956
(1) Anesthesiology 18 1 14 Jan Feb 1957

cheal cuffs and effect a seal, when the breathing bag is compressed manually to develop pressures between 15 and 20 mm Hg in a circle system, range between 90 and 220 mm Hg The wide variations are due to the differences in size of cuffs, volumes of air necessary to inflate them, distance between the wall of the catheter and the interior of the trachea

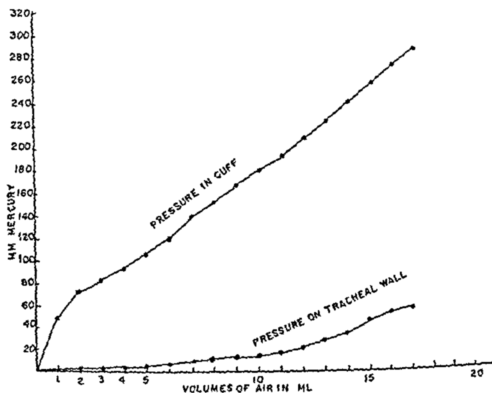


Fig 116—Typical curve showing relation between intracuff pressures and lateral pressures exerted by cuff on wall of the airway with increase in volume of air distending cuff (Courtesy of Adriani J and Phillips M Anesthesiology 18 1 14 Jan Feb 1957)

and the thickness and elasticity of the rubber composing the cuffs Most of the pressure is expended in overcoming the elasticity of the rubber The pressure exerted by the cuff on the tracheal wall (Fig 116) varies between 10 and 15 mm Hg when inflated to hold pressures ranging between 15 and 20 mm Hg in the breathing bag

Possibility of severe trauma, contusions and laceration of the trachea bronchi or alveoli by rupture of a cuff under ordinary use has been grossly exaggerated Ordinarily, less than 10 ml of air is necessary to inflate most cuffs Volumes

of 40 ml. or more are necessary to cause rupture. Intracuff pressures, when such volumes are used, exceed 1,000 mm. Hg Rupture of cuffs under such circumstances caused no discernible trauma to the trachea, bronchi or lung of dogs.

Incidence of cardiac arrhythmias and reflex circulatory disturbances is no greater with cuffed than with uncuffed catheters There is no correlation between the act of inflating the cuff and the development of cardiac arrhythmias.

The cuff is 100% effective in preventing aspiration of gas-

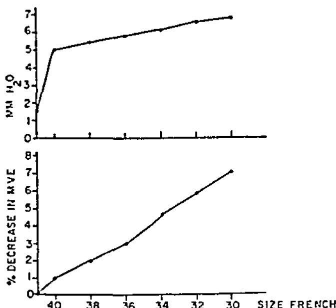


Fig 117—Increase in respiratory effort and decrease in minute volume exchange using catheters of varying size with inflated cuffs in 2 4 cm airway Data obtained with mechanical bellows ventilator Upper figures represent increase in resistance in terms of negative pressure on inspiration in bellows due to decrease in cross sectional area of airway Lower line is decrease in minute volume exchange as per cent of control which occurs simultaneously with increase in resistance (Courtesy of Adriani, J, and Phillips, M *Anesthesiology 18 1 14, Jan Feb, 1957*)

tric contents from the pharynx into the trachea. The pack does not insure against aspiration. Incidence of aspiration when the pack is used is identical to that when intubation is done without a pack or cuff.

Routine use of a single-sized endotracheal catheter for all patients, e g., a 32 F., without a cuff causes decreased minute volume exchange and increased ventilatory effect (Fig. 117). This resistance *increases progressively* as the diameter of the catheter is decreased in an airway of constant internal

diameter Under similar circumstances using a catheter with an inflated cuff, a simultaneous increase in ventilatory effort corresponding to a negative pressure of 10 mm of water, and a reduction of minute volume exchange of 7% occurred when a 30 F catheter was used The negative pressure which developed with a 40 F was 2 5 mm of water and the decrease in minute volume exchange was less than 1%

Pooling of secretions between the tracheal wall and catheter in the area distal to the inferior edge of the cuff occurs only when the steep head-down position is used and the edge of the cuff is relatively far from the end of the catheter

Mechanisms in Development of Postintubation Granulomas of Larynx are discussed by William S Howland and John S Lewis[2] (Mem'l Center for Cancer, New York) who reviewed analyzable cases of postintubation laryngeal granulomas This condition favors females 7 1

Granulomas may occur on the vocal cords elsewhere than on the vocal process of the arytenoid cartilages The highest incidence arises after head and neck surgery during which the head is extended, often with pillows or sandbags under the shoulders This places the larynx at a considerably higher level than the head, forcing the endotracheal tube against the posterior portion of the glottis

In only one patient could development of the granuloma be directly attributed to trauma In this patient, bronchospirometry was discontinued because of inability to insert the tube between the vocal cords One week later, the patient was hoarse but laryngoscopy revealed no granuloma Six weeks after intubation a granuloma was discovered on the anterior third of the right vocal cord

The incidence of pre existing respiratory infections in patients in whom postintubation granulomas develop may be significant especially as a source of irritation to an abraded laryngeal mucosa The time recorded for the development of the granulomas postoperatively was usually that at which the patient complained of hoarseness or respiratory obstruction This varied from 2 to 28 weeks

Transtracheal Analgesia Its Place in Anesthetic Practice is discussed by J B Coughlin D C Grosskreutz and C R Stephen[3] (Durham, N C) Transtracheal topical analgesia is

(2) Ann Ot l Rh n & Laryng 55 1006 1011 December 1956
(3) South M J 50 508 515 April 1957

a distinct aid to maintaining smooth, light planes of anesthesia. During induction, the danger of laryngospasm, with its concomitant anoxia, is reduced. Irritant drugs, such as ether, may be given smoothly, without breath-holding. Endotracheal intubation may be performed in light planes of anesthesia without fear of reactions such as "bucking," breath holding or bronchospasm. During maintenance of anesthesia, the head may be moved freely from side to side



Fig. 118.—Proper position of patient and needle for transtracheal analgesia Needle is placed through cricothyroid membrane (Courtesy of Coughlin, J B, *et al.*: South. M. J. 50:508-515, April, 1957.)

without fear of reaction on the endotracheal tube. With transtracheal analgesia, it is possible to reduce the total amount of anesthetic given to the patient and at the same time provide a smooth, light plane of narcosis. Patients awaken at the end of the operation with removal of the tube.

Technic.—The transtracheal technic has evolved because practice has shown that direct instillation of a local anesthetic solution into the trachea, with subsequent coughing, spreads the analgesic more evenly and thoroughly. The optimum position for injection is to have the patient supine with the head extended as much as possible. The patient's chin should be held up so the mouth is tightly closed. This position brings the larynx and trachea in close proximity to the skin, making the skin taut over these structures (Fig. 118). Injection may be made through the cricothyroid ligament, which extends between

the thyroid and
a small amount (
ture to be penet
cartilage is easily palpated with the neck extended, and an injection just superior to this cartilage is ideal and precludes damage to the vocal cords Less commonly, the puncture is made between the cricoid cartilage and the first tracheal ring In this position, less space is available for injection and the possibility of transfixing the isthmus of the thyroid gland is greater

A standard 20- or 21 gauge needle attached to a 2 cc syringe is used for injection Intradermal anesthesia is not used because the skin of the neck is not unduly sensitive The patient is informed of the procedure and asked not to talk, cough or swallow until told Undue movement of the larynx can result in trauma or a broken needle Proper placement of the needle is recognized easily by the loss of resistance noted as the syringe is advanced Confirmation is obtained by aspirating a bubble or two of air Injection of the solution and removal of the needle must be done rapidly as the flow of solution on the trachea almost invariably promotes active coughing The size of the needle used is important If it is too small, the rate of injection is delayed and coughing may begin before the syringe is empty, thus initiating the hazard of needle breakage If the needle is too large, there is a possibility of fistula formation between trachea and skin The transtracheal deposition may be made with the patient either awake or under light anesthesia

Potential major complications include cellulitis spreading from the track of the needle, permanent fistula formation transesophageal penetration with mediastinitis and breakage of the shaft of the needle with difficulty in removing the distal portion

Enlargement of the thyroid gland or tumor formation which overrides the salient landmarks of the thyroid and cricoid cartilages renders the technic dangerous Active disease of the tracheobronchial tree, including carcinoma of the larynx or tuberculosis, is a contraindication

Comparison of Two Systems of Anesthesia for Thoracic Surgery. Ether versus Thiopental-Succinylcholine Henry K Beecher[4] (Harvard Med School) reports on thiopental sodium succinylcholine chloride anesthesia (Pentothal®-Anectine®), used at the rate of about 4,000 cases/year over a considerable period for all types of major surgery, including the longest and most complicated thoracic procedures He believes that because of its greater controllability this

(4) J Thoracic Surg 32 419 423, October 1956

agent is considerably superior to various forms of curare used for much the same purpose.

Both ether and succinylcholine produce a fairly heavy flow of saliva and mucus in many subjects. Succinylcholine, with its transient action and easily varied depth of muscular paralysis, is better than ether for control of cough. One anesthesia regimen is as good as the other in most patients undergoing thoracic surgery, except in obstruction of the airway when swift intubation and aspiration are essential. In this case, the muscle relaxant sequence is better. It is also probably preferable when severe emphysema is present, used with a ventilator which provides for use of both negative and positive pressure. Ventilator systems have now been so developed that they are more effective than the manual bag-squeezing system in maintaining adequate ventilation. It is felt they work better with muscle relaxants than when ether is used.

Extensive use of thiopental with the muscle relaxant may constitute a considerable hazard to the circulatory system. Thiopental is exceedingly poorly tolerated by bled-out persons or those with crippled cardiovascular systems. The tendency to peripheral stagnation of blood with he thiopental-succinylcholine sequence may or may not be important. Muscle relaxants undoubtedly permit more dependable control of motion in the thorax than ether does. There is no hazard of explosion with the thiopental-muscle relaxant sequence.

► [As is so often the case, there is a tendency in this report to assign favorable responses to the drug and technic rather than to the manner in which it is employed. The evidence presented in this report is insufficient to support the statements relative to the superiority of the succinylcholine, thiopental nitrous oxide combination over any other agent or combination.—Ed.]

Place of Trichloroethylene in Obstetric and Anesthetic Practice is discussed by L. W. Fabian, C. R. Stephen and M. Bourgeois-Gavardin[5] (Duke Univ.). The preparation of trichloroethylene currently used is highly purified and marketed as Trilene® and Trimar. Highly stable under ordinary circumstances, the drug can be decomposed to some extent by exposure to excessive heat and light or to alkali. Contact of the vapor with highly alkaline substance becomes a clinical

(5) South. M. J. 49 808-814, August, 1956

problem in that halogenated derivatives may be produced by using trichloroethylene in closed circuit anesthesia Carbon dioxide absorbents such as soda lime and Baralyme serve as the alkaline medium in such a system

In animal experiments, it appeared that conversion from a technic of intermittent self-administered analgesia to one of partial rebreathing or even closed circuit anesthesia offered no hazard from formation of toxic substances from a chemical reaction between trichloroethylene and soda lime The factors considered important in providing this safety are use of fresh soda lime and of high flow rates of gases and partial rebreathing technics Short periods of closed circle absorption technics should also present no such dangers All soda lime which has been in contact with trichloroethylene must be discarded to prevent reuse Decomposition of the loose molecular combination of dichloracetylene or mono chloracetylene with soda lime is the real problem and may be avoided if soda lime exposed to Trilene® vapor is never reused

► [One should not interpret the report to permit use of trichloroethylene freely with soda lime It must be noted that the qualifications of high flow rate and use of fresh soda lime are essential Actually if high flow rates are used soda lime is unnecessary —Ed]

Report of Seven Administrations of Chloroform for Open Thoracic Operations is presented by Karl L Siebecker and O Sidney Orth[6] (Univ of Wisconsin) Of the 7 patients 2 died of acute centrilobar necrosis of the liver, and 2 presented clinical and laboratory evidence of toxic hepatitis Examination of the anesthesia records of both patients who died revealed that there were periods of hypotension and bradycardia during administration of chloroform Administration of chloroform in the presence of possible hypoxia or hypercarbia or both probably caused the hepatic damage Adequate assurance of oxygenation and ventilation to remove carbon dioxide are primary requisites in safe use of chloroform

Model Experiments on Absorption Efficiency of Soda Lime I I und O Lund and H Erikson[7] undertook to elucidate experimentally the influence of flow rate and degree of humidity of respiratory gases on the efficiency of soda

(6) Anesth [illegible] l gy 17 792 797 Nov Dec 1956
(7) Brit J [illegible] th 29 17 20 January 1957

lime. With a CO_2 production of about 200 ml./minute and a CO_2 of 0.6% in the inspired air, soda lime, types A and B (A being coarser grained than B), gave sufficiently good absorption for about 3 hours, provided ventilation was even and did not exceed about 7 L./minute. If ventilation increased to about 10 L./minute, the same types of soda lime were equally efficient for 2½ and 3 hours, respectively, whereas at ventilations of about 15 L./minute, satisfactory absorption lasted for 1 and 2 hours only.

The fact that absorption efficiency is so dependent on the flow rate through the canister explains why the efficiency varies with the type of respiration. A brief increase in ventilation from any irregularity of respiration, such as coughing, immediately reduces absorption efficiency. The CO_2 content in inspired air increases. This increases ventilation and thus the speed of flow through the canister. In this way, a vicious circle is established leading to inefficient CO_2 absorption in many instances. This should be considered also when controlled ventilation is being used. Too energetic artificial ventilation automatically results in poorer absorption. If the expired air cools and loses humidity before it reaches the canister, the soda lime's efficiency is also reduced.

► [It should not be overlooked in considering this report that the authors have chosen not to include the very profound influence of canister size, channeling, etc., on the efficiency of absorption. It should be understood that the observations made apply to the type of canister used and not necessarily to other (particularly larger) canisters —Ed]

RELAXANTS

Potassium Depletion and Central Action of Curare were studied by Patrick A. Foster[8] (Univ. of Liverpool). For more than 10 years competent observers have reported abnormal, apparently central, actions of all the relaxants in common clinical use. In many of these potassium depletion was a complicating factor. Two general features frequently have been recorded: (1) apparent resistance to the relaxant —either depolarizing or antidepolarizing—seemingly produced by central motor stimulation; (2) respiratory depres-

(8) Brit. J. Anaesth 28:488-502, November, 1956.

sion linked with unconsciousness For such central actions to occur, the relaxant must pass the blood-brain barrier This may be achieved with high blood levels of the drug, but the threshold for penetration may be lowered in certain disturbances of water and electrolyte metabolism, of which potassium depletion may be the essential common feature

In 8 patients abnormal responses were noted to the antidepolarizing relaxants, d-tubocurarine chloride and gallamine A disturbance of potassium metabolism was found in every patient, sometimes associated with dehydration and other electrolyte depletion The nature of these abnormal responses indicated a central action of these drugs, sometimes with fatal results

Physiologic treatment would be replacement of lost potassium other electrolytes and water Because of urgency, rapid intravenous infusion may be preferred The total body potassium level may be about 4,000 mEq, of which 1,000 or more may be lost Since the total extracellular potassium level is only 140 180 mEq, danger of extracellular overloading by rapid replacement is apparent Calcium intravenously antagonizes the dangerous effects of raised blood potassium levels and glucose and insulin administration hastens the shift of potassium into the intracellular space where it is required Monitoring by ECG during the infusion may forewarn of toxic effects

► [The coincidence of relaxant administration and potassium depletion is evident The relationship of the two events is not established —Ed]

Suxamethonium and Respiration · Investigation of Possible Central Action of Suxamethonium Chloride during Clinical Anesthesia The respiratory center aims at maintaining for itself a stable environment in respect of Pco_2 and pH and does so by altering rate and depth of respiration If a standard adequate inflation of the lungs is substituted for each attempt at inspiration the patient is deprived of one of his adjustment mechanisms Depth of respiration is then fixed but the respiratory center can still respond to change in arterial Pco_2 Po_2 and pH by altering the rate at which it initiates attempts at respiration In such a system, the anesthetized patient freed from cortical and reflex disturbance of respiration can maintain the arterial Pco_2, Po_2 and pH levels which best suit his respiratory center The arterial

P_{CO_2} will be reflected by the alveolar P_{CO_2} and its sustained rise will indicate a diminished sensitivity of the respiratory center to its normal driving force.

To investigate the possible central action of suxamethonium, L. T. Rees and M. H. Armstrong Davison[9] (Royal Victoria Infirm., Newcastle upon Tyne) used the following anesthetic procedure.

METHOD.—After light premedication 1 hour before anesthesia, sodium thiopentone was given slowly in a 5% solution, just sufficient to induce sleep. Nitrous oxide-oxygen and ether were then given by a Boyle machine, until oral intubation with a size 10 cuffed tube could be atraumatically performed. Anesthesia was maintained in plane 1 of stage 3, until successive end-expiratory air samples, containing equal CO_2 concentrations, were obtained. The patient was then connected to a machine performing artificial respiration in a closed circuit. The respirator was set to inflate the lungs two or three times a minute, with a nitrous oxide-oxygen-ether mixture from the same Boyle machine. Under such circumstances, the patient's inspiratory efforts "triggered-off" the machine, and equilibrium, reflected by the end-expiratory CO_2 readings, was soon established. The effect on these readings of giving a known respiratory depressant was then tried to test the method. Pethidine, 25 mg. intravenously, was given to 10 patients and end-expiratory CO_2 samples taken for 15 minutes thereafter.

The CO_2 concentration increased in each patient from 0.3% to 2.1%. When a 0.1% infusion of suxamethonium chloride was given to 10 other patients, the CO_2 readings did not rise; thus, in the dosage given, suxamethonium chloride had no depressant action on the central respiratory mechanism of these patients. However, the possibility of central respiratory depression by this drug in other circumstances or in larger doses is not eliminated.

Action of Succinylcholine on Extraocular Muscles and Intraocular Pressure was studied by John B. Dillon, Phiroze Sabawala, Dermot B. Taylor and Ralph Gunter[1] (Univ. of California, Los Angeles). One of the extraocular muscles of a cat was carefully dissected and placed in a constant temperature bath. When 10 μg. succinylcholine was added to the bath, the muscle promptly went into contracture which was relieved by thorough washing. To demonstrate that succinylcholine caused this type of contracture, a muscle was prepared and blocked with curare. Curare had no effect on the

(9) Anaesthesia 12:57-60, January, 1957.
(1) Anesthesiology 18:44-49, Jan.-Feb., 1957.

muscle and prevented succinylcholine from producing a significant contracture. After thorough washing, however, succinylcholine again demonstrated its effect on the preparation. Human muscles demonstrated the same contracture when small quantities of succinylcholine were added to the bath. Addition of small doses of succinylcholine to in vitro human ocular muscle produced summation, although the demonstration was not as clear as in the preparation of the cat muscle, because of the marked effect of the relatively small dose of succinylcholine on this particular preparation of human extraocular muscle. The amount of rise of intraocular pressure seemed related to the rate of drainage of the aqueous.

Succinylcholine is probably not the muscle relaxant of choice in ocular surgery, and it would be preferable to use some other, specifically curare, which produces neither increase in intraocular pressure nor contracture of extraocular muscles.

► [There is always a tendency in encountering a report of this nature to exclude the use of a drug completely on a sort of generic basis. There is probably no good reason for excluding succinylcholine in patients undergoing ophthalmologic surgery *unless* the procedure is such that an increase in intraocular tension is hazardous.—Ed.]

Postoperative Muscle Pains. Patricia Hegarty[2] studied 14 hospital patients who received suxamethonium chloride; 20% had postoperative muscle pains. Combining a second depolarizing muscle relaxant with suxamethonium chloride does not increase the incidence of pain and may decrease it. Patients in whom relaxation was obtained by other means had complete absence of these pains. Suxamethonium chloride provides profound relaxation with rapid reversal, but a neuromuscular blocking agent that acts for 5 minutes and causes unpleasant sequelae that may stretch into the 3d postoperative day is not "short acting" in any true sense. The postoperative immobility which it may impose might favor development of unpleasant or dangerous postoperative complications. Some patients who were surgically fit for discharge perforce remained in bed another 48 hours to recover from the effects of suxamethonium chloride. Routine use of suxamethonium chloride should be restricted to patients in whom its advantages outweigh its risks.

(2) Brit. J. Anaesth. 28:209-212, May, 1956.

Acute Tolerance to Thiopentone in Man. John W Dundee, Henry L. Price and Robert D. Dripps[3] (Univ. of Pennsylvania) analyzed the average doses of thiopentone used in combination with nitrous oxide-oxygen to produce surgical anesthesia in comparable series of patients anesthetized at

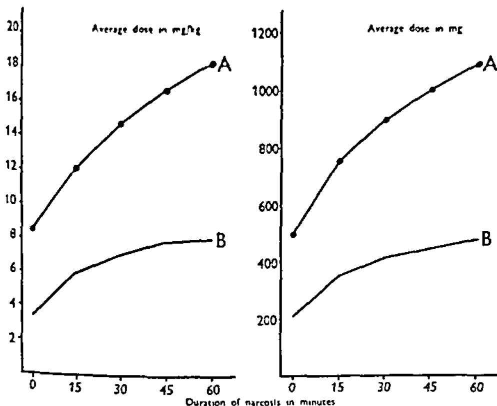


Fig 119—Comparison of average doses of thiopentone required during anesthesia in two series of patients *A*, United Liverpool Hospitals, *B*, Hospital of University of Pennsylvania (Courtesy of Dundee, J W, *et al* Brit J Anaesth 28 344-352, August, 1956)

the Hospital of the University of Pennsylvania and at various hospitals in Liverpool. It was found that, for any given period of anesthesia, the British anesthetists administered about twice as much thiopentone as their American counterparts (Fig. 119). Recovery appeared to be equally prompt in each center.

Irrespective of the initial dose of thiopentone, a constant

(3) Brit J Anaesth 28 344 352, August, 1956

relation was found between total dose and initial dose of the drug at any given duration of anesthesia (Fig 120) Within the dosage range used in clinical anesthesia, a linear relation was found between the blood thiopentone level at which patients awaken from a single injection and the amount injected

When the total dose of thiopentone did not exceed three times the induction dose, there was a striking relation be tween the latter and the blood thiopentone levels at which patients awaken, but no correlation could be found between

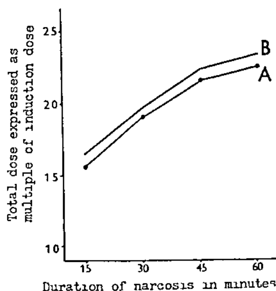


Fig 120 —Comparison of ratio of total dose of thiopentone required during an esthesia to induction dose in same series of patients (Courtesy of Dundee J W *et al* Brit J Anaesth 28 344 352 August 1956)

blood thiopentone levels at awakening and the total dose of the drug When this range of dosage was exceeded, the total dose also played a part in determining the blood thiopentone level at which patients recover

The observations can be reconciled by the hypothesis that acute tolerance to the depressant effects of thiopentone on the central nervous system develops rapidly, the degree of adaptation being proportional to the peak concentration of thiopentone in the brain, whether this occurs during induc tion of anesthesia or after a supplementary dose of the drug

Clinical Application of Studies of Physiologic Disposition of Thiopental Thiopental is metabolized very slowly in man

at a rate of only 10-15%/hour. The rate of chemical transformation is not altered by use of adjuvant drugs, such as nitrous oxide, morphine and curare. Plasma concentrations of thiopental bear no fixed relation to the signs of anesthesia.

Lester C. Mark, J. J. Burns, Bernard B. Brodie and E. M. Papper[4] administered thiopental intravenously to dogs for 5 minutes and at various intervals thereafter took samples of plasma, liver, gluteus muscle and lumbodorsal fat for analysis by spectrophotometry. Concentrations of the drug in liver and plasma were maximal immediately after administration, whereas concentrations in muscle, though also high, continued briefly to rise further. Liver, muscle and plasma concentrations then declined in parallel fashion, rapidly for the first hour and then more slowly. However, concentrations in fat were negligible at the beginning of the experiment but rose rapidly to a peak in about 3 hours. Fat levels then fell gradually, parallel to, but about 10 times higher than, those in liver, muscle and plasma.

Craniotomies were performed in dogs during cyclopropane anesthesia. The cyclopropane was then blown off rapidly, and thiopental administered intravenously. At various times thereafter, samples of brain and plasma were taken and analyzed for thiopental content. Maximal concentrations of drug appeared in the brain almost instantly. The brain and plasma concentration time curves fell parallel and as in plasma, liver and muscle. Thus, no barrier to passage of thiopental into the brain was found.

The rapid recovery from a small dose of the drug is evidently not due to rapid biotransformation but to localization in fat depots. The prolonged depressant effects of repeated or sustained administration of thiopental are due to its slow rate of metabolism in the body.

REGIONAL ANESTHESIA

Local Anesthetic Toxicity: Pharmacologic Re-evaluation. Allergy seldom is the mechanism of the clinical intoxication with local anesthetics Rather, the fatal reactions to these

(4) New York J. Med 56 2819 2822, Sept 15, 1956

drugs should be considered on the basis of their characteristic pharmacologic actions on the cardiovascular and central nervous systems In animal experiments, John E. Steinhaus[5] (Univ. of Wisconsin) found that local anesthetics stimulate only the cortical areas and that their effect on the medulla is primarily depressive (Fig. 121) Their action on the cardio-

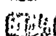




Fig 121—Effect of cocaine on movement, respiration and blood pressure of rabbit when injected into blood supply of lower brain stem. (Courtesy of Steinhaus, J E Anesthesiology 18 275 281, Mar Apr, 1957)

vascular system likewise is chiefly depressant (Fig 122), although this system is much more resistant than the brain, especially in the presence of adequate oxygenation Recent use of some of these agents in cardiac resuscitation indicates that even complete cardiovascular depression is reversible

The treatment for the effects on the central nervous system is primarily one of maintaining respiration Convulsions can be controlled with a thiobarbiturate, but great care must be taken that additional depression is not superimposed.

(5) Anesthesiology 18 275 281 Mar Apr, 1957

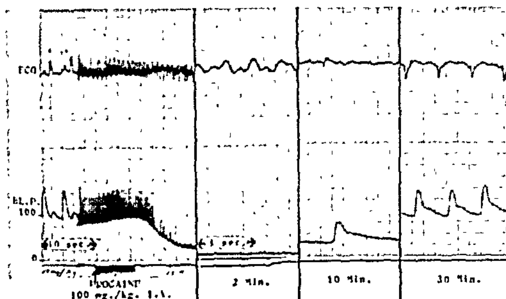


Fig. 122.—Blood pressure and ECG tracings of dog after intravenous injection of 100 mg./kg. procaine, and subsequent resuscitation. (Courtesy of Steinhaus, J. E. Anesthesiology 18:275-281, Mar.-Apr., 1957.)

There is little evidence that barbiturates counteract the depressant action which these agents have on the respiratory center. Depression of the cardiovascular system can be treated with small doses of epinephrine or Arterenol®. If complete arrest is produced, cardiac massage should be instituted.

▶ [One should not overlook the critical point made in this article regarding depression of vital centers. The dominating phenomenon of convulsions associated with a reaction to local anesthetics may lead one to assume, incorrectly, that large doses of depressants are needed. The dose required to quiet the stimulated cortex will serve only to add depression to other areas already depressed by the local anesthetic.—Ed.]

Systemic Toxic Reactions to Local Anesthetics are discussed by Daniel C. Moore and John Green.[6] Onset of a systemic toxic reaction to a local anesthetic drug is usually announced by a faint, giddy feeling or the sensation of "blacking out." Speech becomes incoherent and irrational, and unconsciousness and apnea ensue. Twitching of the fingers may follow, which often rapidly develops into generalized convulsions. Vomiting may occur, with or without aspiration. Untreated, the patient may convulse two or three more times, get progressively worse and die. Usually, these signs and symptoms following topical application of a

(6) California Med. 85 70-74, August, 1956

local anesthetic agent progress more rapidly than when they result from a regional nerve block.

At the first sign of a reaction, oxygen should be given by bag and mask immediately The patient's respirations should be assisted if depressed; if breathing stops, artificial respiration by rhythmic squeezing of the bag must be begun An effective exchange, evidenced by expansion of the chest and upper abdomen, at the easy rate of about 24 breaths/minute is usually satisfactory. If a patent airway cannot be maintained, an endotracheal tube should be considered If the patient vomits, vomitus must be cleared from the pharynx, larynx and trachea before oxygen is given If the patient is unconscious, the airway must be cleared by suction and, on occasion, by bronchoscopy. Effective administration of oxygen alone will probably avert circulatory collapse and death in most patients

If blood pressure falls markedly, rapid intravenous administration of ephedrine sulfate or Neosynephrine® should be begun to return pressure to nearly normal After one or two general convulsions, if it appears that adequate oxygenation of the patient alone does not effectively prevent further convulsions, Pentothal® should be sparingly given intravenously Analeptics, such as caffeine and Metrazol®, are contraindicated as they increase the oxygen demand of cells, and may accentuate the depression which will follow overstimulation

Reactions during Topical Anesthesia are discussed by Max S Sadove, Raymond F Rose, Myron J Levin and Edward deR Cayia[7] (VA Hosp, Hines, Ill), who observed 2,100 cases of topical anesthesia during 2 years There were 27 adverse reactions True reaction to the local anesthetic was seen in 18 patients There was 1 death, in a patient who was moribund when the procedure was begun Atypical reactions attributable to the local anesthetic agent were observed in 3 patients, 2 had exacerbation of an asthmatic state and 1 repeated laryngospasms Some form of psychomotor activity developed in 2 patients, whereas 4 were overdepressed from excessive premedication Except the 1 who died, all patients made uneventful recoveries with no sequelae

(7) Illinois M J 109 315 320 June, 1956

Proper use of topical anesthetic agents before endoscopic procedures requires thorough evaluation and preparation of the patient preoperatively. Special problems concerning the patient and psychologic preparation are important. Premedication should be tailored to suit the given patient. Administration of the topical anesthetic agent should be carefully controlled and the patient watched closely at all times There should be preparation to manage any emergency which might arise Thorough knowledge of the systemic effects of local anesthetic agents, types of reactions and their proper management is essential. The problem is primarily one of maintenance of oxygenation and circulation without over-depressing or stimulating the patient Most reactions, if recognized early and treated properly, subside promptly and leave no sequelae.

Transvaginal Pudendal Nerve Block—Safe Anesthesia in Obstetrics: Report of Seven Years' Experience. John H. Dugger, Eugene E. Kegel and John J. Buckley[8] (Episcopal Hosp, Philadelphia) found transvaginal pudendal nerve anesthesia a safe and satisfactory procedure for delivery and repair.

TECHNIC—The patient is carried through the first stage of labor with small doses of analgesia, such as Demerol® (50 mg.) and scopolamine (1/50-1/300 gr.), administered intramuscularly and repeated as indicated every 3-6 hours. When delivery is imminent, she is transferred to the delivery room and prepared She may be given the Duke Inhaler to self-administer Trilene® during contractions Then a pressure-controlled syringe containing 10 cc of 1% Xylocaine® is attached to a 6-in. 20 gauge needle The syringe is held in the right hand. The barrel of the needle is placed between the index and middle fingers of the left hand with the needle parallel to the fingers The index and middle fingers of the left hand are introduced into the vagina, so that the finger tips sheathe the needle point The left ischial spine is located, and the needle is advanced through the vaginal mucosa, the fingers directing its course inferior and posterior to the spine for about 0 5 cm. If no blood is obtained after aspiration, 10 cc Xylocaine® are injected The procedure is then repeated on the opposite side by reversing the hands Anesthesia should be effective in 2-3 minutes, and if not satisfactory in 5-10 minutes, the procedure should be repeated on one or both sides.

► [There is no doubt that pudendal block for vaginal delivery is a satisfactory anesthetic procedure However, it is pointed out that the author

(8) Obst & Gynec 8 393 395, October, 1956

in these circumstances is reporting on the end result of the use of narcotics (Demerol®), Trilene® *and* pudendal block —Ed]

Epidural Anesthesia in General Surgery was used by P C Lund, J C Cwik and R Magaziner[9] (Conemaugh Valley Mem'l Hosp , Johnstown, Pa) in 2,110 consecutive patients More than half received Surital® sodium to allay apprehen sion or render induction of this form of anesthesia painless Xylocaine® was used as the local anesthetic agent in various amounts (table)

The major complications were marked falls in blood pressure in 8 patients, hypertension in 1, massive epidural block

INJECTION SITE AND DOSAGE

Procedure	Site		Xylocaine 2%	
			Minimum	Maximum
*Thoracic	C_7 T_1	T_9 T_0	10 cc	20 cc ↓
Gastrectomy	T_0 T_1	T_{12} L	35 cc	50 cc ↑
Cholecystectomy	T_0 T_1	T_2 L_1	30 cc	45 cc ↑
Appendectomy	L_1 L_2	L_2 L_3	20 cc	30 cc ↑
Inguinal herniorrhaphy	L_2 L_3	L_3 L_4	15 cc	25 cc ↓
Total hysterectomy	L_1 L_2	L_2 L_3	20 cc	35 cc ↑
Vaginal hysterectomy	L_3 L_4	L_4 L_5	20 cc	25 cc ↓
Hemorrhoidectomy	L_3 L_4	L_4 L_5	15 cc	20 cc ↓
Lower extremity	L_3 L_4	L_4 L_5	20 cc	25 cc ↓

↑ Bevel of needle directed cephalad
↓ Bevel of needle directed caudad
*Thoracic 1 5% xylocaine®

and marked depression or drowsiness in 4 each and massive or total subarachnoid block in 2 Mild convulsions occurred in 5 patients and severe ones in 11 The incidence of minor postoperative or postanesthetic complications such as headache backache, nausea and vomiting was remarkably low In 3 patients anesthesia could not be excluded as a contributory factor to sudden death during the first 5 postoperative days

It is felt that epidural anesthesia, despite its hazards, should be added to the armamentarium of the modern anesthesiologist because it induces less physiologic disturbance than any other method which provides comparable relaxation

(9) Anesthesiology 17 605 615 July Aug 1956

Effect of Local Anesthetics on Motility of Upper Gastro-intestinal Tract was studied by Herbert Schapiro and Edward R Woodward[1] (Los Angeles) They found that direct administration of local topical anesthetic agents into the stomach and duodenum of 9 human subjects, 7 of whom had no gastrointestinal disease, was without discernible effect on gastric and/or duodenal motility in 6 In 3 patients, there were minor and seemingly inconstant changes in gastric or duodenal activity; in each, the trend was toward a decrease Tonus and motility of the pyloric sphincter were not measured As previously reported, topical anesthetic drugs prevent or ameliorate acid-induced peptic ulcer pain This relief is seemingly unrelated to change in motor activity

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SPINAL ANESTHESIA

Long-Term Follow-up of Patients Who Received 10,098 Spinal Anesthetics: Syndrome of Decreased Intracranial Pressure (Headache and Ocular and Auditory Difficulties) The headache that frequently follows spinal anesthesia is sometimes associated with visual and auditory difficulties and dizziness The headache may be totally incapacitating, and may persist for months after anesthesia Severe headache may be accompanied by paralysis of one of the extraocular muscles This syndrome was studied by Leroy D Vandam and Robert D Dripps[2] (Univ of Pennsylvania) in 9,277 spinal anesthetizations Over-all incidence of the headache was 1,011 (11%) The oldest patients were least susceptible to it, and women, especially during pregnancy, were more susceptible than men Incidence when needles of small diameter were used was much less than that with needles of large diameter, a 22-gauge needle was found best for routine use Headache could be virtually eliminated by use of a 24-gauge needle Data on duration and time of onset of the headache, on the effects of postural changes and on the visual and auditory phenomena indicate that this syndrome is due to the effect of decreased cerebrospinal fluid pressure in intracranial blood vessels and nerves The decrease is caused by

(1) Proc Soc Exper Biol & Med 92 143 145 May 1956
(2) J A M A 161 586 591 June 16 1956

leakage of the fluid The local anesthetic employed for spinal anesthesia did not affect the appearance of symptoms Lowered intracranial pressure could not be demonstrated in every patient, for the modifying factors in any instance can be many, and the physiologic alterations may be relatively slight to produce the ultimate symptoms

Exacerbation of Pre-existing Neurologic Disease after Spinal Anesthesia. The chief dissatisfaction with spinal anesthesia centers about the neurologic complications that are probably inherent in the method To clarify this problem, Leroy D Vandam and Robert D Dripps[3] did a 6 month to 5-year follow-up study on 10,098 spinal anesthetics After 89%, no severe progressive neurologic disease occurred Most lesser sequelae were related to lumbar puncture and would be largely preventable by careful technic Certain minor neurologic defects were noted, none was progressive nor of consequence These would also be minimized by attention to asepsis and choice of reliable local anesthetics

The authors present 11 cases in which spinal anesthesia was given inadvertently to patients with pre existing neurologic disease and a case in which meningitis developed after anesthesia (table) The 11 patients had one of the following spinal cord tumor, herpetiform lesions, healed encephalitis degenerative disease possibly due to a cerebrovascular accident, protruded intravertebral disk metastatic cancer of the spine and diabetes with possible peripheral neuropathy In each patient, there was some exacerbation of symptoms and signs following anesthesia, often with recovery

It should not be assumed that a cause-and-effect relation between anesthesia and recrudescence of neurologic disease was established in every case in this series On the contrary, a new process ascribable to anesthesia could not be established in any In cases ending in death there seemed to be inexorable progression of disease that had begun long before the anesthetic was given In others, spinal anesthesia introduced previously symptomless disease, which was cured after correct diagnosis Although a cause-and-effect relation between spinal anesthesia and exacerbation of disease was not shown, spinal anesthesia should not be given a patient with

(3) New England J Med 255 843 849, Nov 1 1956

ANTECEDENT NEUROLOGIC DISEASE AND POSTOPERATIVE NEUROLOGIC SEQUELAE

Case No.	Neurologic Disease	Age	Sex	Operation	Lumbar Puncture	Anesthetic	Postoperative Sequelae
		yr.					
1	Undiagnosed spinal cord meningioma	[illegible]	F	[illegible]	[illegible]	Pontocaine [illegible]	[illegible] sensory & motor [illegible] changes [illegible] laminectomy
2	Undiagnosed herpes zoster	[illegible]	F	Appendectomy	[illegible] lumbar	[illegible]	Transient sensory & motor [illegible] leg
3	History of mumps encephalitis	[illegible]	F	Cholecystectomy	[illegible]	[illegible]	[illegible] weakness of leg [illegible]
4	History of cerebrovascular accident [illegible] leg pain [illegible] bladder weakness	9	F	Diagnostic spinal anesthesia	Multiple spinal taps	[illegible] procaine	[illegible] leg pain & bladder weak[illegible]
5	History of sciatic pain	9	M	[illegible]	[illegible]	[illegible]	Reappearance [illegible]
6	History of [illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	[illegible]
7	History of backache	68	F	[illegible]	[illegible]	[illegible]	Reappearance of backache
8	Spinal [illegible]	77	M	[illegible]	[illegible]	[illegible]	[illegible] leg pain after 6 m[illegible]
9	[illegible]		M	[illegible]	[illegible]	[illegible]	Delayed onset of back & leg pa[illegible]
10	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	[illegible]
11	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	[illegible]
12	[illegible]	[illegible]	M	[illegible]	[illegible]	[illegible]	[illegible]

central nervous system or spinal column disease This applies to congenital, healed, inactive and active disease It embraces trauma, bacterial and viral infections, degenerative diseases, neoplasms and systemic diseases with neurologic accompaniments Exceptions to the rule may be made only when anesthesia other than spinal is potentially more hazardous or less safe in the hands of the person administering it

MISCELLANEOUS

Control of Diabetes Mellitus in Surgical Patients is discussed by R C King[4] (St Bartholomew's Hosp, London) Diabetes should be diagnosed before operation and in most cases, control established with soluble insulin and a diet of at least 150 Gm carbohydrate daily The exact time of operation should be predetermined and to insure this diabetics should, if possible, be first on the operation list Operation should be performed as early in the day as practicable and the patient should reach the theater with an empty stomach and adequate glycogen reserves During and after operation blood sugar should be maintained with normal limits Continuous administration of intravenous glucose with soluble insulin every 4 or 6 hours is the safest and most effective means of insuring good control of the diabetes Local anesthetics should be used wherever possible, and ether or chloroform anesthesia avoided The degree of control must be followed by frequent urine examinations (using an indwelling catheter if necessary) or by frequent blood sugar estimations

In practice, some operations on mild diabetics may be performed under general anesthesia without insulin These are usually minor operations, or those after which infection is not expected Giving glucose solution by mouth preoperatively is widely advocated As with solid food, it may fail to prevent hypoglycemia, particularly if absorption is not complete by the time anesthesia is induced, and it may cause vomiting

► [One should be careful in interpreting the statements regarding the choice of anesthetic agent and technic Local anesthesia is often preferable but it should not be considered mandatory nor should ether and chloroform be rigidly excluded The presence of diabetes should not be the primary factor in determination of agent and technic —Ed]

Pharmacology and Pheochromocytoma are discussed by R A Millar[5] (Montreal Neurological Inst) Drugs used in diagnosis of pheochromocytoma may provoke an episode of

(4) Anaesthesia 12 30 41 January 1957
(5) Brit J Anaesth 29 50 65 February 1957

paroxysmal hypertension or induce hypotension by antagonizing the peripheral effects of circulating pressor amines The first group includes histamine, mecholin and the tetraethylammonium compounds The precipitate rise in blood pressure with severe headache and acute anxiety produced by these drugs, has frequently caused concern, more serious effects, e g multifocal ventricular extrasystoles, have also been reported Lowering the legs and other postural changes may prevent a dangerous pressor effect, placing the patient on a tilting table would be a useful safeguard However, routine testing with hypertensive agents does not now appear justifiable, their use is probably best reserved for patients with paroxysmal hypertension in whom hypotensive drugs are less useful When employed, an effective epinephrine blocking drug should be at hand (in addition atropine may be required if methacholine chloride is used) The second group of drugs are the adrenergic blocking agents β chlor ethylamines (Dibenamine® and Dibenyline®), benzodioxane compounds (e g , piperoxan) ergot alkaloids and the imidaz oline derivatives (tolazoline and phentolamine) Although all these show a reasonably specific adrenergic blocking action their different behavior results from direct actions on various tissues

All sedatives and narcotics should be omitted during the 24 hours before a pharmacologic test for pheochromocytoma The safest agent is phentolamine 5 mg intravenously A positive result is indicated by a fall in blood pressure greater than 35 mm Hg systolic and 25 mm Hg diastolic, occurring within 2 minutes of injection and persisting at least 2 min utes Piperoxan may be used to confirm a positive phentola mine test 20 mg piperoxan being injected over 2 minutes into a saline infusion A positive result is shown by prompt fall in blood pressure which returns to the basal level in 5 minutes

Paper chromatography may also be used as a diagnostic aid When 0 05 ml of an acid alcohol extract of normal urine is applied to paper the amounts of epinephrine and nor epinephrine are too small to be seen the lower limit of de tection being 1 μg A rough quantitative guide to the activity of a pheochromocytoma may be obtained from the appear

ance of the epinephrine and norepinephrine spots which should be clearly visible when a urinary extract is chromatographed A rapid screening procedure for hypertensive patients has also been described Urine is passed into a clean jar containing 50 mg ascorbic acid, the sample is refrigerated until assay, which uses cat blood pressure on which neutral samples of untreated urine may be tested

Preoperative care to combat epinephrine intoxication should include a full diet to build up reserves of liver glycogen (Symington and Goodall, 1953), a high salt content has also been recommended Interference with adrenal cortical function may be counteracted with intramuscular cortisone 25 50 mg twice daily, with 5 mg DCA daily, for 2 days preoperatively Adrenergic blocking agents should be given as required Phentolamine, in oral doses of 25 75 mg every 4 or 6 hours, is safe and easily managed, a hypertensive crisis can be aborted with 5 mg phentolamine intravenously

If the site of a pheochromocytoma is known, adequate access is usually obtainable through a posterolateral kidney incision, with resection of the 12th rib if necessary Bilateral transverse upper abdominal incision is favored if the site of the tumor is indefinite Hypotension and circulatory failure immediately following tumor removal is counteracted by blood transfusion and vasoconstrictor therapy, e g, infusion of norepinephrine, 2 mg of active base or phenylephrine 40 mg/L of glucose saline solution Doses of norepinephrine up to 100 μg/minute may be required to maintain a good pressure level postoperatively

Adrenal Response to Stress before Operation, during Anesthesia and during Surgery One response of the body to stress is stimulation of the adrenal glands to secrete various corticosteroids A primary value of the adrenocortical hormones is mobilization of energy for cellular work Since surgical procedures may involve considerable stress Robert W Virtue and Mary Louise Helmrich[6] (Univ of Colorado) tried to evaluate the various factors involved during operation Free plasma dihydroxycorticosteroids were determined before and during anesthesia and during and after surgery as a measure of body response to stress

Values obtained 1 and 2 days before surgery were not sig

(6) Proc Ro Soc Med 49 492 494 July 1956

nificantly different from those immediately before Blood steroid levels were not elevated during an hour of cyclopropane anesthesia, nor during an hour of nitrous oxide thiopental However, 11 of 27 patients receiving ether for an hour showed elevation of blood corticosteroid level Blood steroid levels rose during surgery in direct relation to the intensity of the procedure They continued to rise for several hours the highest level was reached some time after the end of surgery

Anesthesia and Surgery in Adrenocortical Insufficiency are discussed by John W Dundee[7] (Univ of Liverpool) Adrenal insufficiency may be due to primary or secondary hypoadrenocorticism or to surgical removal of adrenal tissue Adequate substitution therapy with cortisone and similar drugs makes patients with Addison's disease amenable to anesthesia and major surgery though morphine should not be used and thiopentone only with caution Patients with the Waterhouse Friderichsen syndrome require the same management

Secondary hypoadrenocorticism occurs in any condition in which there is hypofunction of the anterior pituitary gland depriving the cortex of its normal stimulus of adrenocorticotropin Adrenal crises have been described in hypopituitarism Prolonged coma is liable to occur, ushered in by masked hypotension and salt depletion, hypoglycemic attacks are common, and hypothermia may also occur, prolonging the coma Patients with pituitary hypofunction who have not been prepared by specific hormone therapy are as liable to collapse with the stress of surgery and anesthesia as patients with primary adrenocortical hypofunction

Adrenocortical insufficiency may occur in patients with pituitary tumors Some degree of endocrine dysfunction is probably present in nearly all patients with a craniopharyngioma though it is less likely to be apparent in children Since the operative procedure may in itself compromise pituitary function where this is not already too depressed preoperative administration of cortisone or ACTH has been suggested as a routine procedure even in surgery in the parasellar region as a prophylactic against the complications of operative trauma to the hypothalamus or pituitary

(7) Brit J Anaesth 29 166 180 Apr 1 1957

gland Adrenocortical insufficiency may also be induced directly by cortisone and similar drugs or indirectly by ACTH

Patients with adrenocortical insufficiency receive 100 150 mg cortisone daily for 2 days before operation and the same dose intramuscularly 1 hour before induction of anesthesia Postoperatively, 25 50 mg is given parenterally every 4 6 hours, the frequency of administration being gradually decreased over 7-10 days until a satisfactory maintenance dose is obtained if necessary

A growing accumulation of clinical data suggests that in many patients, appearance of intractable hypotension—not accounted for by blood loss posture etc —during anesthesia and *surgery may be a manifestation of failure of the adrenal* cortex

Oxygen Consumption and Mechanical Efficiency of Hypothermic Heart were studied by Kurt R Reissmann and Robert L Van Citters[8] (Univ of Kansas) Cardiac oxygen consumption in canine heart lung preparations was compared at 37 C and 27 C in relation to equal cardiac work/unit of time/beat In unit time, the hypothermic heart used less oxygen than the normothermic heart at equal work performance and the absolute difference in oxygen consumption remained nearly constant over a wide range of work loads A pronounced positive correlation between mechanical efficiency and increasing output loads of the hypothermic heart was found and explained the relative high cardiac oxygen demands in the intact hypothermic animal At equal work/beat the hypothermic heart used slightly less oxygen/beat than the normothermic despite its greater diastolic volume The lower oxygen consumption of the hypothermic heart was attributed to slower rate and depressed resting cardiac metabolism The greater efficiency of the slow heart implies that a greater stroke volume is discharged more efficiently The positive correlation between efficiency and output load at a constant heart rate is another manifestation of this

Effects of Hypothermia on Physiology of the Nervous System. Since the introduction of hypothermia as a surgical adjunct has become increasingly apparent that much of

(8) J ⁴ₚ Phys ol 9 427 430 November 1956

the utility of this technic depends on its effects on the physiology of the nervous system. Hypothermia is being currently used to produce generalized reduction in body metabolism which permits interruption of the circulation to vital centers for longer periods than can be tolerated at normothermic levels. Thus, arterial supply to the brain may be occluded as long as 20 minutes at 68 F. and flow to the spinal cord for 90-180 minutes at 73.4-78.8 F. without risk of producing neurologic deficit. Intricate cardiovascular and neurologic surgery can be accomplished which before was extremely hazardous or impossible. It has been assumed that total body and cerebral oxygen consumption parallel each other during hypothermia, but direct measurements of cerebral functions have not been made. Hubert L. Rosomoff[9] (Columbia Univ.) reviewed results of a series of experiments to evaluate the effects of temperature reduction on the nervous system and correlated these findings with information available from the literature.

During hypothermia there is a decrease in cerebral blood flow, corresponding decline in cerebral metabolism, compensated hypotension, decrease in brain volume, diminution of intracranial pressure and depression of electric and reflex activity. The influence of temperature on the nervous system is remarkably consistent. All functions studied to date have shown a progressive depression of activity with lowering of temperature, affording advantages which could be important in investigation and treatment of abnormal states of the nervous system. Reports have begun to appear which indicate that hypothermia is of value in the therapeutic approach to certain neuropathologic processes, particularly those involving vascular components of the brain.

Anesthetic Explosions are discussed by C. S. Jones[1] (Univ. of Cape Town). They occur about once in every 7,500,000 anesthetics. However, risk of death from the anesthetic itself is greater than 1 in 2,000.

Anesthetic explosions almost invariably are due to neglect of elementary precautions. This neglect is usually due to ignorance and sloth. An explosion usually results from a rapid chemical reaction which liberates large volumes of gas

(9) Surgery 40:328 336, August, 1956
(1) South African M J 30 861 864, Sept 8, 1956

into a confined space These volumes rapidly increase the pressure in the confining vessel, which bursts The sudden shock waves, flying splinters of the burst vessel and the fire frequently started by the heat evolved in the chemical reaction are responsible for whatever other damage may result

Certain conditions must be satisfied before the chemical reaction can take place The chemicals which are to take part in it must be in physical contiguity This requirement extends to the molecular level In mixtures of ether vapor and air, for example, the ether molecules are widely separated from the oxygen molecules, with which they would unite, by interspersed nitrogen molecules which are chemically inert The ether and oxygen molecules in mixtures of ether vapor and oxygen are jostled together and are much more closely related than in ether air mixtures In either, if the mixture is under increased pressure, the molecules are more closely packed The closer the physical contiguity of the potentially reactive molecules, the more likely is a reaction to occur if the other conditions are also satisfied

The second condition for reaction is the spark Gases, like liquids and solids, have specific heat properties, and the molecule itself absorbs the heat (or energy) If the molecules in the vicinity of the energy quantum have an increased capacity for absorbing heat, they will absorb and dissipate the energy supplied as well as separate the reactive molecules, so that the chemical reaction will not be initiated Hence the nature of the mixture containing the reacting agents, and the physical conditions under which it exists, play an all important part in the subsequent events when a quantum of energy (ignition source) is added to the mixture

Response during Anesthesia and Surgery Effect of Psychologic Factors Empiric evidence of the importance of the effects of psychologic factors in surgical response led to the hypothesis that there is a relation between psychologic or personality factors and stability of response during surgery

Four classes of psychologic variables, which may be important in surgical response were identified by Fred H Herring[2] (VA Hosp Fort Lyon Colo) They were "predictor" variables i e psychologic and/or physiologic meas

(2) Psychosom Med 18 243 251 1956

urements of preoperative patients, predictions made by clinical psychologists using psychologic measures to forecast surgical stability, "criterion" variables of physiologic measurements during surgery, and clinical evaluations made by anesthesiologists using these measures Thus it was possible to search for relations between any of the factors considered pertinent

After a sample of psychologic variables and tests to measure them were selected, 25 patients were examined preoperatively Clinical psychologists attempted to predict the patients' stability of surgical response by using only the psychologic test protocols Patients were given extra clinical tests to assure normal physical status, and their surgical and anesthesiologic management was standardized Comparable types of surgery were performed on the patients Physiologic measures taken during surgery were evaluated by anesthesiologists who determined stability of surgical response These studies demonstrated the possibility of finding a relation between psychologic factors and patient response to surgery under anesthesia

Rorschach reaction time, deformed responses on the Rorschach, and cold pressor test results showed promise for continued investigation of specific factors which may help predict unstable response during surgery Clinical psychologists using various psychologic test protocols could predict, somewhat in excess of chance, not only the physiologic surgical stability but the evaluations of anesthesiologists of patients' clinical stability There was objective confirmation of the importance of changes in systolic blood pressure as a major index used by anesthesiologists

Role of Hypnosis in Anesthesiology is discussed by Milton J Marmer[3] (Univ of California, Los Angeles) Hypnosis has much to offer the anesthesiologist It minimizes fear and apprehension and is a valuable adjunct to measures commonly used in sedation before and after operation It can be attempted when chemical anesthetics are contraindicated Posthypnotic suggestion has proved of great value postoperatively, in reducing or eliminating nausea, vomiting and pain Hypnosis is a successful auxiliary measure for inducing

(3) J A M A 162 441-443 Sept 29 1956

anesthesia and can effect anesthesia alone. Patients vary in susceptibility to hypnosis, and a deep hypnotic level cannot be reached in all. Ideally, hypnosis should be used in combination with chemical agents for anesthesia. The only disadvantage to hypnosis is that its effective application requires considerable time, which is more than offset by its many advantages.

The author performed thoracotomy and resection of the lingula pulmonis with hypnosis in a woman, 25, who had previously undergone diagnostic bronchoscopy under hypnosis. The patient was hypnotized the night before and again at 10 a.m. on the day of operation. Medication before and during the operation included 100 mg. pentobarbital and 50 mg. diphenhydramine hydrochloride by mouth, 100 mg. meperidine hydrochloride and 0.40 mg. scopolamine hypodermically, 50 mg. thiamylal sodium intravenously to stop involuntary swallowing, 25 cc. of 1% solution of procaine hydrochloride infiltrated into the skin before the incision and a total of 100 mg. succinylcholine administered as 0.1% solution by intravenous drip during 45 minutes to control respiration.

► [Many still regard hypnosis in the same light as did the critics of Mesmer and the fanatics of the days of Salem witchcraft. Evidence continues to accumulate, nevertheless, to indicate that the fundamental principles associated with its use are beneficial.—Ed.]

Anesthesia for Cardiac Surgery 1949-56. Jack Moyers[4] (State Univ. of Iowa) reports results of a 7½-year experience with anesthesia in cardiac surgery (Fig. 123). Of 533 patients who had surgery, 58% were under age 20. The primary anesthetic agent in patients under age 10 usually was ether; for those over 10, it was usually nitrous oxide. Mortality rates for individual operative procedures were comparable to those usually reported. Although lack of improvement in mortality rate might seem to reflect lack of progress, improvements may have been nullified by ever-expanding and more courageous applications of surgery. Experiences derived from anesthesia for cardiac surgery improve the anesthetist in other areas of surgery, and by communication he can share these experiences with colleagues, residents and students. There are problems peculiar to this field of anesthesia in pre-

(4) J. Iowa M. Soc. 47:192-196, April, 1957.

	49 50	50 51	51 52	52 53	53 54	54-55	55-56	1956 6 mos	Total Cases	Percent Mortality
Patent Ductus	7 1	14	5	19	22	19	19	5	110 1	09
Coarctation of Aorta	1	4 1	7 1	4	8	6 1	9	6	45 3	67
Tetralogy of Fallot	6 1	2	4 1	4 1	9 1	8	6 2	2 1	41 7	171
Mitral Stenosis		2	19 1	28 1	50 2	42 2	41 2	29 2	211 10	47
Constricting Pericarditis		1	1	2		3 1	1		8 1	125
Aortic Arch Anomaly			2	4 1	2 2	1		1	10 3	300
Pulmonary Stenosis				2	13 1	3	5	6	29 1	34
Miscellaneous (Exploratory)				2 1	6 3	7 1	6 3	4	25 8	320
Interatrial Septal Defect					2 1	11 2	13 3	11 1	37 7	189
Interventricular Septal Defect							1	11 2	12 2	167
Aortic Stenosis							2	3 1	5 1	200
TOTAL	14 2	23 1	38 3	65 4	112 10	100 7	103 10	78 7	533 44	83
Percent Mortality	143	43	79	62	89	70	97	89	83	

Fig 123 —Summary of experience in cardiac surgery at Iowa State University Hospitals, July 1, 1949 to Dec 31, 1956 Years were computed from July 1 to June 30 Small underlined numbers show deaths (Courtesy of Moyers, J J Iowa M. Soc 47 192 196, April, 1957)

operative evaluation, selection of anesthetic agents, conduct of anesthesia (including use of hypothermia and the pump oxygenator) and postoperative care. These concepts do not demand of the anesthetist new basic concepts but merely an appropriate application of principles which have been practiced for some time.

Maternal Deaths from Obstetric Anesthesia and Analgesia: Can They Be Eliminated? Charles S. Stevenson, Harold A. Ott, Palmer E. Sutton and Mary Lou Byrd[5] (Detroit) found that anesthesia is the fifth most common cause of maternal death in Michigan. Spinal anesthesia was responsible

(5) Obst. & Gynec 8 88 98, July, 1956

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(5) Obst & Gynec 8 88 98, July 1956

TABLE 1—Type of Anesthesia and Degree of Responsibility for Maternal Death

		Inha	I V Demerol®	I V	Barbiturate and Morphine plus		Accidental Overdosage with	
risk patient	15	5	2	1		1	1	25
Direct precipitating cause—poor risk patient	4				1			5
Probable contributing cause, with or without other factors		2						2
Possible contributing cause with or without other factors	1	1						2
Total	20	8	2	1	1	1	1	34

TABLE 2—Anesthesia and Anesthetist

		M D Anes	Nurse Anes	Attending	Resident	Un		Data Unob
plus I V Pentothal®	1		1					
Accidental overdosage with epinephrine	1			1				
Inhalation								
Open drop ether	3		1		1	1		
Nitrous oxide—oxygen-ether	2		2					
Nitrous oxide—oxygen	1					1		
Cyclopropane—nitrous oxide—oxygen	1		1					
Cyclopropane ether	1		1					
Total	34	2	6	13	7	2	1	3

for 60% and inhalation anesthesia for 23% of 34 maternal anesthesia deaths in Michigan in 1950 through 1953 (Table 1) Excessive dosage, improper technic and use when contra indicated were the main lethal factors in the 20 deaths from

spinal anesthesia Anoxia, aspiration of vomitus and cardiac arrest were the fatal factors in the 8 deaths from inhalation anesthesia.

The heart of the problem is demonstrated in Table 2, which shows that the skill of the person giving the anesthesia (i e, the technic) is far more important than either the agent or the method used Pudendal nerve block anesthesia is adequate for nearly all vaginal deliveries and, according to published reports, is the safest form for both mother and infant This is true provided heavy analgesic dosage during labor is not used For cesarean section, local infiltration is the safest form of anesthesia

Anesthesia for Emergency Surgery is discussed by J R Gordon, D S P. Weatherhead and F H Van Bergen[6] (Minneapolis). Treatment of the obstructed airway is of immediate importance All mucus and blood must be aspirated from the air passages and solid foreign matter removed. The continuity of the airway may be temporarily maintained by holding patient's jaw and tongue well forward and, if necessary, by inserting an oropharyngeal airway In the unconscious patient, the best method to effect and maintain a continuously patent air passage is by endotracheal intubation with a cuffed Magill tube Inflation of the cuff prevents further aspiration of foreign substances into the tracheobronchial tree

If the protective laryngeal reflexes are still present, they must be obtunded by translaryngeal anesthetization of the laryngotracheal mucosa A 20-gauge needle is inserted through the cricothyroid membrane into the lumen of the larynx and 2 cc of 5% solution of Cyclaine® is rapidly injected In addition, the mouth and pharynx may be sprayed with a nebulizer to obtain topical anesthesia above the glottis Intubation then is readily accomplished

When tracheotomy is necessary, a cuffed, kink-proof tracheotomy tube is preferable to the standard silver tube, especially if anesthesia must be given subsequently The tracheobronchial tree may be thoroughly suctioned by utilizing the curvature of a specially designed long catheter to aspirate selectively both main stem bronchi

(6) Minnesota Med 39 803 811 December 1956

In addition to a patent, protected airway, it may be necessary to initiate or compensate ventilation Respiratory paralysis may follow head or neck injuries, and respiratory impairment may result from insults such as pneumothorax blast injuries and ruptured diaphragm A normal minute volume can best be secured by application of intermittent

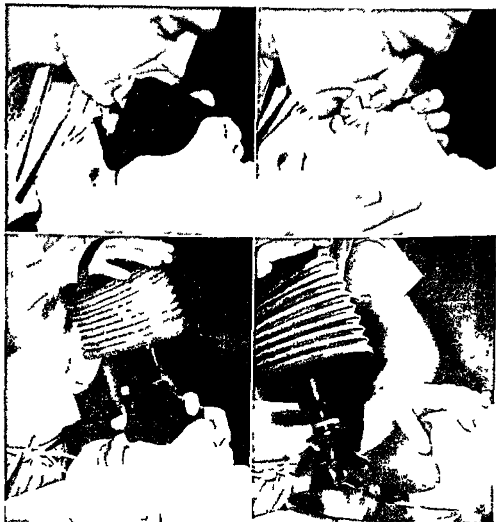


Fig 124 (top left) —Mouth to mask respiration Operator supports patient s jaw with fingers of left hand and inflates lungs by blowing into mask If patient s tongue obstructs air flow oral airway is inserted

Fig 125 (top right) —Mouth to tube breathing Operator blows through an endotracheal tube at rate of about 15 times/minute

Fig 126 (bottom left) —Kreiselman hand bellows respirator As bellows type bag is elevated by hand strap room air is sucked in through valve at top of bag By compressing bag air is delivered to patient s lungs A second valve between mask and bag permits expired air to escape

Fig 127 (bottom right) — Connecting elbow is used to facilitate drainage from respiratory tract with patient on his side

(Courtesy of Gordon J R *et al* Minnesota Med 39 803 811 December 1956)

positive pressure breathing, although in emergencies simpler methods, such as mouth-to-mouth breathing, may be lifesaving (Figs. 124-127)

In shock, the circulatory blood volume is restored by intravenous infusion through a 15-gauge needle While waiting for whole blood for transfusion, plasma or dextran may be used. Other therapeutic measures include Trendelenburg position with elevation of the legs, oxygen administration and intravenous injection of vasopressors

The hypertensive response to injury usually subsides after induction of general or spinal anesthesia Autonomic blocking agents are also effective.

Poor stress responses may be seen in the aged and debilitated, patients who have been under mental stress and tension for long periods and patients who have received ACTH or cortisone therapy during the preceding year Such persons show minimal or no homeostatic response to illness or injury and a gradual deterioration in blood pressure, pulse and respiration. They respond poorly to the usual resuscitative measures. Treatment of choice is 100-200 mg hydrocortisone

Local infiltration and regional nerve block are the safest anesthetic technics in the severely ill A patient in shock should not be given a spinal anesthetic Paralysis of the sympathetic fibers maintaining vasomotor tone results in precipitous falls in blood pressure

Recent reports indicate that use of ether may be hazardous in the seriously ill patient Cyclopropane is especially useful in the urgent surgical patient because of the absence of deleterious metabolic upset and the minimal alteration of peripheral circulatory dynamics with better maintenance of compensating cardiovascular responses in shock Deep anesthetic planes with cyclopropane, however, are as harmful to the shock patient as with Pentothal® or diethyl ether

Nitrous oxide, which has low anesthetic potency, can be effectively combined with other agents, such as in nitrous oxide-oxygen, intravenous barbiturate and muscle relaxant technics

Some Reasons for High Mortality in Pediatric Anesthesia are presented by Robert M Smith[7] (Harvard Med School) One cause of death is the common practice of anesthetizing

(7) New York J Med 56 2212 2216, July 15, 1956

children without having basic equipment available Necessary equipment includes suction (working and in reach), oxygen and appropriately sized airways, endotracheal tubes and laryngoscopes (Fig 128)

Another outstanding reason why children die during anesthesia is that many are hurried to the operating room while toxic and dehydrated Surgery should be delayed until toxicity is controlled by fluids and antibiotics

Pediatric anesthesia demands meticulous, continual ob-

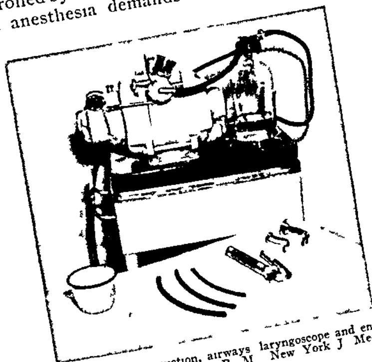


Fig 128 —Basic equipment suction, airways laryngoscope and endotracheal tubes in appropriate sizes (Courtesy of Smith, R M New York J Med 56 2212 2216, July 15 1956)

servation Danger signals must be recognized and their cause corrected at once Some important danger signs are depressed, obstructed or jerky respiration, marked flaccidity, pallor or cyanosis, weak pulse and bradycardia dilated pupils,

Replacement of fluid and blood probably represents the greatest problem in major pediatric anesthesia Saline has been responsible for deaths in infants and must be used sparingly Errors in rate and amount of fluid given are the most common Many deaths have been caused by drowning small patients by rapid administration of fluid It is commonly held that an infusion of 10 ml blood/lb will not overload a child

Often this is not enough, however. Measurement of blood loss is definitely helpful in determining replacement needs.

Several technics have been suggested for management of patients with full stomachs. Washing out the stomach is favored by some, but seems unreliable because the large chunks of food often are retained. The safest method is to examine and premedicate the child, then either maintain the gag reflex by use of nitrous oxide or local anesthesia or induce general anesthesia and protect the trachea by passing an endotracheal tube, keeping it in place until the child is fully awake, is opening his eyes and is ready to cry or speak. The endotracheal tube maintains a free airway despite copious vomiting. All vomitus can be safely cleared away before extubation.

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